The FOUNDRY

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Castings Lock Ships Through New Welland Canal

ONE of the greatest feats of modern engineering, one which has been under construction for the past 14 years and up to the present has cost the Canadian government over $114,000,000, is the new Welland canal. The canal connects Lakes Erie and Ontario between which there is a difference in water level of 326.5 feet. Seven locks are included in the project which have a lift of 46.5 feet each. The lock designated as No. 8 is the largest in the world, being 1380 feet long. Ground around the project is being landscaped to make it a beautiful scenic section. Foundrymen should find more than scenic beauty to attract them since many castings have been used in the project. Hundreds of gray iron castings have been used as copings along the side of the canal. Bollards, stationed at intervals along the locks and used to help moor the ships in place during the lowering of the water level, contain many castings. Steel castings form the huge hinges on the lock gates and that material also was used in the fingers which help keep the locks in position when they are closed. Many other uses could be cited to show the part castings play in construction engineering.

Aerial View of the Canal in Which Castings Played an Important Part

Find Where Castings Can Be Sold

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Sound M

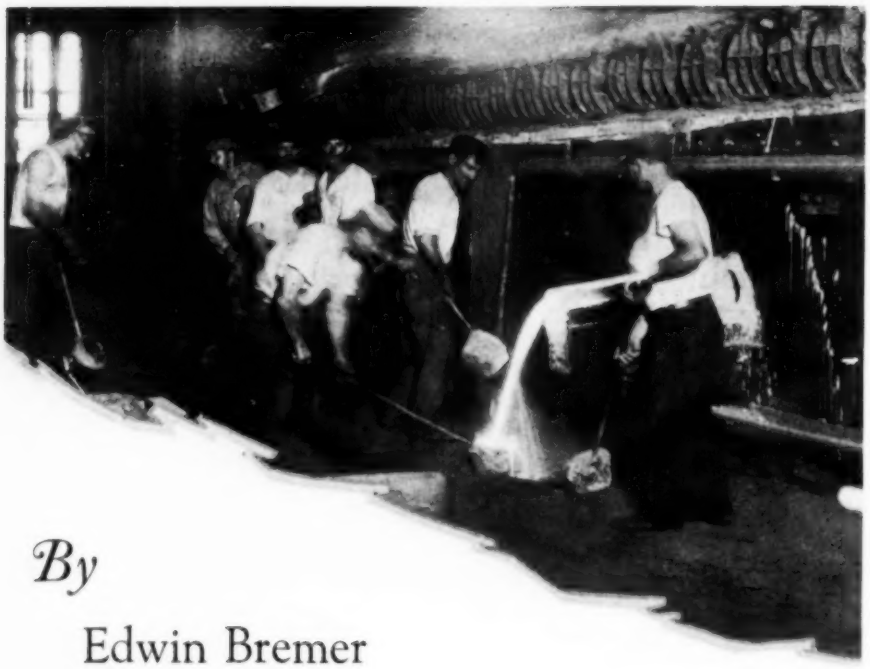


Fig. 1—Once the Upper Taphole Is Opened, the Iron Flows Continuously Until the Molten Bath Drops to the Level of the Bottom of the Hole. Then the Lower Hole Is Opened and the Flow Continues Until the Furnace Is Empty

By

Edwin Bremer

EVERY foundryman aims to supply castings to his customer with the utmost dispatch. To that end, whether he produces gray iron, brass, steel or malleable iron castings, he endeavors to plan his foundry so that the various operations from receiving the pattern to shipping the finished product are expedited as much as possible. The ideal method would be to receive the pattern and raw materials at one end of the foundry and ship the finished castings at the other. While that is not always possible in the strictest interpretation, a close approach usually is made in that from the molding floors, the castings are moved forward progressively through the chipping, grinding and cleaning departments, to the inspectors who pass them to the shipping department.

That method is employed in producing castings at the Maumee Malleable Castings Co., Toledo, O. The molten metal is distributed to the various molding floors, where it is poured into the molds. After the metal has solidified, the castings are shaken out and transferred to the hard iron cleaning room. After cleaning, the castings are transported to the annealing room, and heat treated. Following the heat treatment or anneal, as it usually is called, the castings are transferred to the soft iron cleaning department where they are ground and cleaned and straightened where necessary. After a final in-

Fig. 2—A View of the Molding Floors from the Center Looking Toward One End

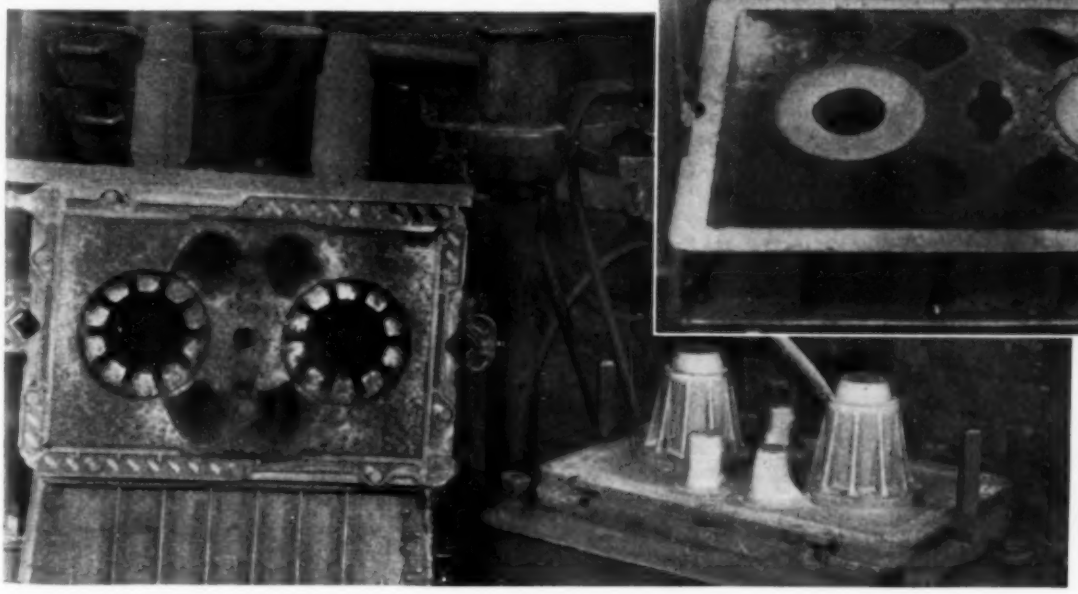
Malleable Iron Castings
Depend on Feeding Methods

spection the castings are ready for shipment.

The various departments are arranged so that castings are moved progressively without backtracking as the operations are performed. Raw material for the melting furnaces is unloaded from cars onto a long platform along one side of the building. Purchased materials are pig iron, malleable scrap, and steel scrap. Hard scrap or sprue is returned from the foundry to the melting furnaces in large rectangular steel buckets which hold from 1600 to 2000 pounds. Two air furnaces, have capacities of 40 tons each and are situated in a side bay approximately in the center of the foundry. The furnaces are approximately 10 feet wide and 40 feet long with 14-inch walls. The roofs have a gradual downward slope toward the stack end, and the units are fired with powdered coal. Only one furnace is used at a time. The furnaces are charged by buckets transported by two cranes.

Powdered fuel for the air furnaces and the annealing furnaces is supplied by a pulverizing system manufactured by the Holbeck Engineering Co., Cleveland. The system is installed in a separate building situated near that housing the melting furnaces. The floor of the building is about 20 feet below the ground level. Coal from bottom-dump cars drops into a chute which feeds the boot of a vertical, bucket conveyor. At the top of the conveyor the coal passes over a crusher into a rotary, kiln-type dryer. The dried and crushed coal then is elevated and dumped into two pulverizers which reduce the coal to the desired size. The powdered fuel is conveyed to two elevated storage bins from which it is distributed to pipe lines leading to the burners of the furnace.

The foundry is divided into three long bays and molds are made in each except in that portion where the furnaces are located. Molds are made by hand and on over 60 machines of jolt-squeeze and rollover types supplied by Wm. H. Nicholls Co., Inc., Richmond Hill, Long Island, N. Y.; International Molding Machine Co., Chicago; Milwaukee Foundry Equipment Co., Milwaukee, and the Tabor Mfg. Co., Philadelphia. A partial view of the central molding bay is shown in Fig. 2. Each molder pours his own



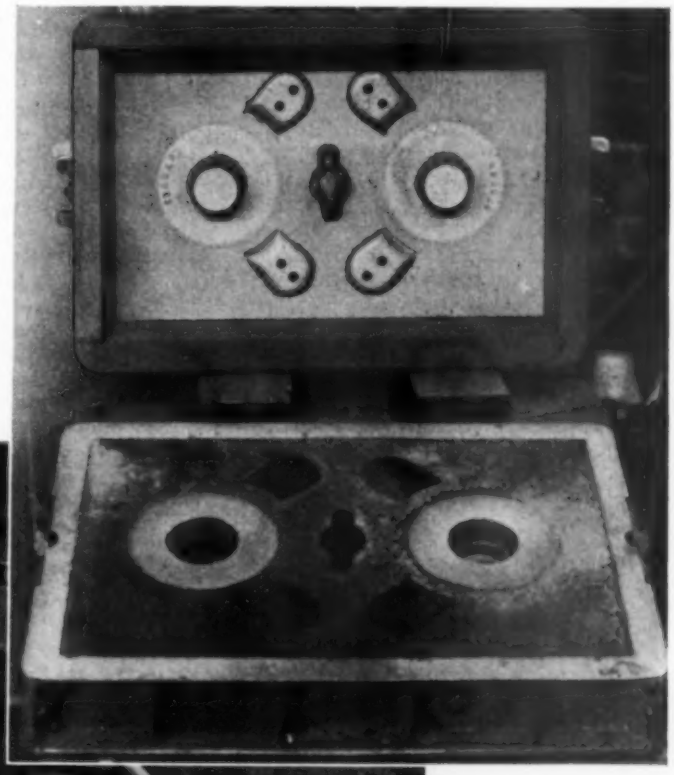


Fig. 3 — (Left) and Fig. 4 — (Above) — Cope and Drag for Flanges

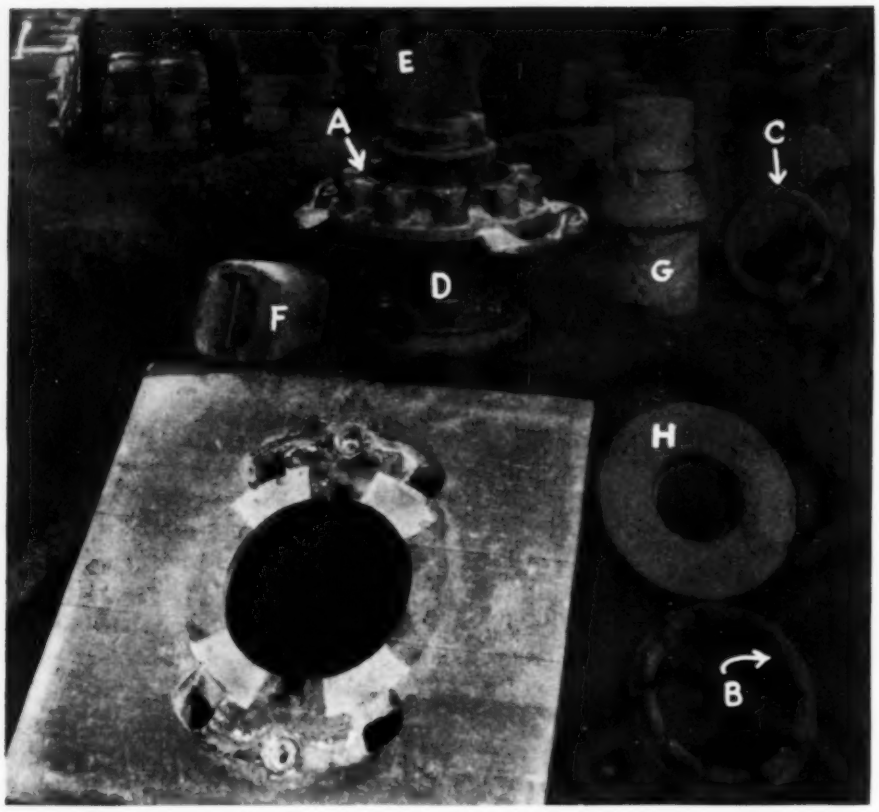


Fig. 5—Pattern and Cores for a Single Flange Hub

floor using hand shanks for the lighter castings and sulky type ladles for the heavier ones. After the castings are shaken out and removed, the sand on the floor is tempered and reconditioned with two sand separators and blenders supplied by the Royer Foundry & Machine Co., Wilkes Barre, Pa.

Sprues, risers and shrink bobs are knocked off the castings and thrown into the long, rectangular steel scrap boxes to be transported to the air furnaces. The castings are put in buckets and taken to the hard iron cleaning room where they are tumbled in 15 barrels supplied by the W. W. Sly Mfg. Co., Cleveland. Then they are transported to the annealing department which contains eight powdered fuel-fired furnaces. The furnaces are arranged in two groups of four furnaces each, placed side by side.

The castings are packed in rectangular, iron pots, with or without packing material. Small, simple castings which readily pack together without danger of warping usually are annealed without packing. The pots are stacked about four-high and separators are placed between the pots so that the weight of castings in the upper pots is not supported entirely by the castings in the bottom pot. Intricate and large castings usually are placed in the pots with layers of inert packing material to support the castings and fill the spaces between castings. The stacks of pots are charged into the furnace with an electrically driven, portable charger. A 5-ton crane supplied by the Cleveland Crane & Engineering Co., Wickliffe, O., is used to convey stacks of pots to and from the fronts of the furnaces, and to dump the pots.

An interesting device is employed in dumping the pots. A chain is wrapped around the top pot in the stack. The pot then is picked up by the crane and moved above a coarse mesh screen 6 feet square mounted on legs about 3 feet high on one end and 4 feet on the other. A few blows of the sledge hammer empties the contents of the pot on the screen. The castings are caught by the screen and slide down the slope. Packing material if used, falls through the screen to the floor.

The annealing cycle usually takes about 8 days from the time the castings enter the furnace until they are ready to handle. The temperature ranges from 1580 to 1600 degrees Fahr. as determined by thermocouples located at the bottom of the furnace, front and back. Approximately 36 hours are required to bring the castings up to the desired temperature at which they are held from 50 to 60 hours. After that period the temperature is allowed to drop at the rate of 10 degrees per hour until a temperature of 1000 degrees is reached. Then the doors of the furnace are opened to cool the pots and their contents as rapidly as possible. When the pots are cool enough to handle, they are dumped.

Following the anneal, the castings are forwarded to the soft iron cleaning department where they are ground on two homemade, electrically-driven, double-stand grinders, and one electrically-driven, double-stand grinder supplied by the U. S. Electrical Tool Co., Cincinnati. A swing grinder supplied by the Norton Co., Worcester, Mass. is used for grinding large, heavy castings. After grinding the castings are cleaned either in sandblast machines supplied by the

Fig. 6—Some of the Metal Is Tapped into Sulky Ladles. Fig. 7—Cores Are Transported on Steel Racks

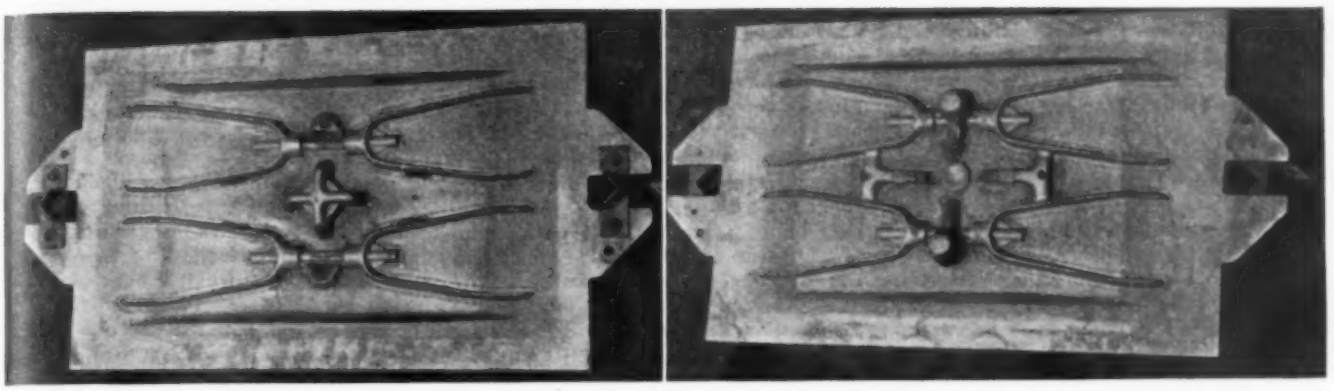


Fig. 8—Drag Plate for Velocipede Forks. Fig. 9—Cope Plate for the Same. The Respective Plates Are Concave and Convex to Give the Proper Contour to the Mold Surface

Pangborn Corp., Hagerstown, Md. and by the American Foundry Equipment Co., Mishawaka, Ind., or in 10 tumbling barrels. Since some of the castings become warped during the annealing process, they are straightened either on five drop hammers or on an oil press. Suitable dies are used in the machines to give the proper contour to the castings.

Cores for the castings are made on the bench and by machines supplied by Wm. Demmler & Bros., Kewanee. Ill., and the Tabor Mfg. Co., Philadelphia. The larger cores are placed on steel racks shown in Fig. 7, and baked in four gas-fired ovens supplied by the Swartwout oven division, Foundry Equipment Co., Cleveland. Lighter cores are baked in a 4-section, drawer type oven supplied by the Whiting Corp., Harvey, Ill. All sand for the cores is stored and mixed in the basement of the core room. Oil sand mixtures are used for all cores and the ratio of oil to sand is about 1 to 60.

Sand for the heavy cores is mixed in a machine supplied by the Standard Sand & Machine Co., Cleveland, and sand for the light cores is mixed in a machine supplied by the National Engineering Co., Chicago. A bucket elevator conveys the mixed sand from the basement to the core room. In addition to its foundry, the Maumee Malleable Castings Co. maintains a well equipped pattern shop which is located above the core room. Equipment includes both woodworking and metalworking machines for the production of wood or metal patterns.

One of the interesting features of any foundry is the methods of molding which are used. White cast iron must be poured at a much higher temperature than gray cast iron because data indicates that gray cast iron will be liquid at probably 230 degrees Fahr. below 2420 degrees Fahr. where white cast iron begins to set. There also is a possibility that the fluidity of white iron at 100 degrees above its freezing temperature is considerably less than that of gray cast iron under the same condition. While white iron begins to freeze at a higher temperature than gray iron, it has a much longer freezing range. Therefore under equal conditions there is a tendency for white iron to contain more shrinks and porous areas due to the larger fluid contraction of the still liquid alloy. Consequently as the temperature of complete freezing is approached, not enough liquid metal remains to fill the spaces between the previously formed solid skeleton.

For that reason special precautions must be observed in making molds for malleable castings. The gates must be large to permit a rapid flow of metal to the mold cavity, risers or feeders must be of sufficient capacity and properly located to supply liquid metal to the voids left in the solidifying casting, and in some cases chills must be provided to promote a uniform rate of cooling. Proper application of any or all of those features depends to a large extent upon the skill and acumen of those directing the foundry operations. In some cases considerable time and effort is devoted to the problem of producing sound castings from difficult patterns.

Figs. 3 and 4 show the cope and drag molds and pattern plates respectively for producing torque tube flanges for one of the more expensive types of pleasure cars. The molds are produced in snap flasks on two jolt-squeeze molding machines on adjoining floors. One machine produces copes and the other produces drags. As may be observed from the pattern for the cope in Fig. 3, the bottom portion of the casting is a flange with a greater metal thickness than the upper portion. The casting is complicated further by the thin ribs springing from the flange. Since under ordinary conditions the flange would solidify last, and the upper portion of the casting would tend to pull away from the slowly solidifying lower portion, means must be provided to promote uniform cooling in all portions, and to supply proper feeding. The former is accomplished

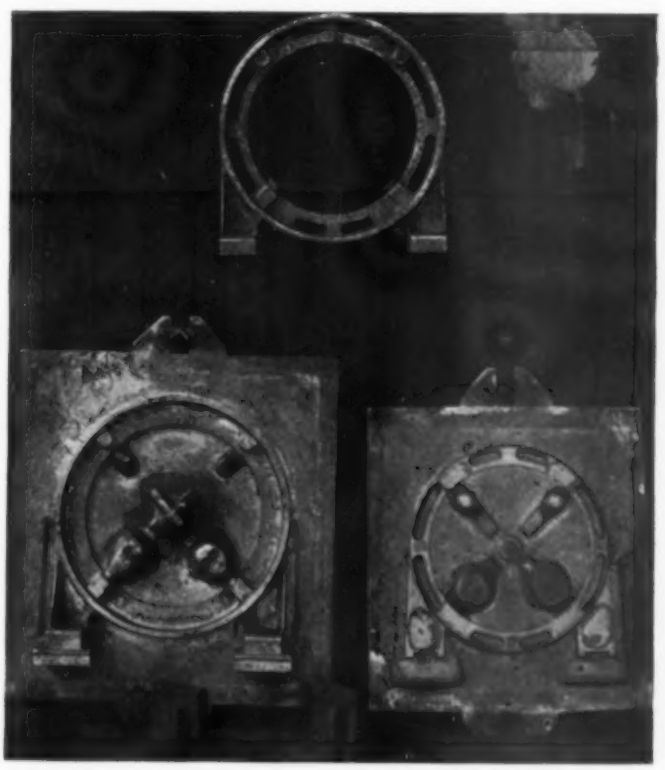


Fig. 10 — Matchplates Showing the Drag and Cope Sides of Pattern for Motor Frames. A Finished Casting is Shown Above

through the use of two large circular chills that form the bottom face of the mold cavity. An ample supply of liquid metal to prevent shrinkage difficulties is assured by the four shrink bobs or blind risers as they sometimes are called.

The mold cavities are filled from a central sprue. As may be seen on the drag pattern in Fig. 4, the end of the sprue looks like wing-nut. The circular portion of the sprue pattern forms a cavity for a small circular strainer core, and the two wing portions allow the metal to flow from the under side of the core up into the branch gates, shrink bobs, etc. which are formed in the cope. Gates to the mold cavities are cut into the circumferences of the flanges at two points as shown in Fig. 3. The cylindrical cores forming the hollow portion of the castings are shown on top of the cope mold at the left in Fig. 3.

Hub Pattern Is Split

One of the most interesting jobs that will be described in detail is the molding of hub castings for automobile busses and trucks. Those are made in the single and double flange types and weigh from 20 to 180 pounds each. The particular one to be described is a single flange hub weighing 90 pounds. Five cores are used in its construction, and the split pattern, follow board, and cores are shown in Fig. 5. The mold is made in a three part flask and the procedure is as follows: The follow board is placed on the floor and the upper portion of the split pattern marked *A* in Fig. 5 is located on the board with the bosses up, that is to say in the position shown. Core *B* is set in the annular channel inside the bosses with the serrated portion down and core *C* is placed on the core print. The latter core acts as a seat for the central core *G* which is put in position later. After the flask is placed in position, a layer of sand is riddled on the pattern and tucked carefully. More sand is thrown on which is peined with the shovel handles. A third layer of sand is put into the flask and peined. One of the molders then steps up on the flask and walks the mold. The sand then is butt rammed all over and struck off. Some loose sand is scattered over the surface and the bottom board rubbed into place.

The bottom board is clamped to the follow board and flask, and the whole is rolled over. The clamps are removed as is the follow board and two small nails are pushed into the sand just inside that portion forming the end of the sprue. The lower portion of the split pattern designated *D* in Fig. 5 which now becomes the upper part is set on the pattern in the drag. The cheek flask is placed in position, and the ram-up core *E* which forms the lower end of the riser is located in its proper position. The sprue plugs are inserted and the wooden plug *F* which forms the upper extension of the riser is set on top of the ram-up core *E*. A layer of riddled sand is thrown into the flask and a few gaggers are arranged to hold the sand in position. The sand then is tucked in and peined lightly.

More riddled sand is thrown in and tucked carefully around the upper part of the pattern. The backing sand is shoveled in a little higher than the edge of the flask and walked. The sand surface is butt rammed and struck off with the shovel. The molders slick the sand carefully around the portion of the pattern which reaches to the surface and around the sprue plugs which extend above. The cope flask containing two longitudinal bars is placed in position and the sand surface is sprinkled with parting. A short extension plug is set on the riser plug in the cheek, and a layer of riddled sand shoveled in. The sand is tucked along the bars and then peined with the shovel handles. Backing sand is shoveled in, walked, butt rammed and struck off.

The sprue plugs are rapped, removed and the sand finished around the opening. The extension riser plug is removed and the opening finished. Then the central portion of the mold is vented thoroughly with a stiff wire. The cope is lifted off, stood on its side and examined. Any loose sand is blown out with the bellows. The swab is run around the pattern and riser plug in the cheek which are rapped and removed. The cheek is lifted off to one side and lightly slicked. The lower portion of the pattern in the drag is rapped and removed. The sand is lightly slicked and the loose sand blown out with the bellows.

Use Strainer Cores

Small circular strainer or skim cores are placed in the depressions formed by the pattern near the end of the sprue, similar to that described previously. The central core *G* is set in position and the cheek is replaced. The cover core *H* then is set in the upper opening in the cheek, and the cope is placed in position. After clamping, the mold is ready to be poured.

Another interesting job is that turned out from the patterns shown in Figs. 8 and 9 which are the drag and cope plates respectively for producing malleable cast iron forks for children's velocipedes. Due to the fact that the forks have a curved portion near the lower end, they cannot be mounted on a flat plate. Consequently, the plates are raised in the case of the cope pattern and depressed in the case of the drag pattern. In other words the surface of the drag is convex while the surface of the cope is concave. A strainer core is used in the sprue as may be divined from the appearance of the print of the sprue on the drag plate which is shown in the illustration, Fig. 8.

Each pattern is gated at two points as depicted in Fig. 9. One gate lies along the side of the core which makes the opening through the head of the fork. The other gate is located at approximately two-thirds of the distance from the lower end of the fork. The latter gate insures a flow of metal to one tine of the fork while the gate cut at the end feeds metal to both tines. Shrink bobs placed at the heads of the forks provide additional metal for the heavier section at that point.

Fig. 10 shows the drag and cope sides respectively of two matchplates for producing two different sizes of motor frames for synchronous motors. While the plates are not the same size, the method of gating, etc., is the same in both cases. The finished casting is shown above the plates. When the matchplates first were put into production, the feet of the frames were solid chunks of iron and due to the heavy section, it was quite a problem to obtain proper feeding at those points. Therefore, heavy shrink bobs were located as near as possible to the feet to supply fluid metal for the liquid contraction taking place during the cooling process. Later, the metal thickness of the feet was made more uniform with the remainder of the casting by the use of small cores which are shown at the bottom of Fig. 10.

Founders Name Speakers

The program for the third annual convention of the Gray Iron institute, which will be held in Cleveland, Oct. 8, contains a number of interesting addresses. Dr. Zay Jeffries, consultant for the Aluminum Co. of America, Pittsburgh, National Tube Co., Pittsburgh, and the General Electric Co., Schenectady, N. Y., will speak on "How Research Is Benefiting Industry"; John S. King, King & Wiley Inc., Cleveland, will discuss "Modern Day Merchandizing"; Phillip P. Gott, assistant manager, trade association department, chamber of commerce of the United States will talk on "The Consumer and Producer Profit Through the Trade Association"; A. C. Denison, president, Fulton Foundry & Machine Co., Cleveland, will lead the discussion on "Reasons Why the Standard Cost System Should Be Used"; and Dan M. Avey, editor, THE FOUNDRY, will summarize the convention activities. A nationally prominent speaker will address the convention following the annual banquet.

Proposed standards for 25 and 800 pound, cast iron, pipe flanges and flanged fittings have been approved by the sectional committee and are being considered by the sponsors preparatory to being submitted to the American Standards association for final approval.

Correct Lighting *Increases* Efficiency in the Foundry

By A. Paulus

SUCCESSFUL foundry operation is dependent upon many factors, one of which is adequate and properly applied artificial illumination. Many investigations and tests have shown that artificial lighting may be a means to the promotion of safety, increased production, reduced spoilage, better sanitation and higher morale among the employes.

Artificial lighting is necessary regardless of whether the work in the foundry is carried on at night or during the day time. For night work, the need for artificial lighting is obvious. Daytime operations are dependent upon artificial light on an average of approximately 2 hours in every working day, due to cloudiness and failing daylight. Some foundries due to the construction of the building require artificial light practically the entire day. Therefore, it is apparent that successful foundry operation and good artificial illumination go hand in hand. The question naturally arises as to what constitutes good artificial illumination. In general, the lighting installation that does not contain such defects as glare, insufficient illumination, nonuniformity, shadows and gloom is considered as good practice.

Glare is the blinding effect produced when one looks at a bare lamp or any other bright light source. To shut out the excessive light, the pupil of the eye closes to an extremely small opening. However, this does not correct the position for vision as the eye under these conditions does not receive an accurate picture of the work. This defect may be corrected by using proper size reflectors deep enough to shield the lamp filament.

Insufficient illumination is probably the most prevalent defect found in foundry lighting installations. Even with perfect eyesight a high intensity of illumination enables one to see more quickly and accurately, but not all workers have perfect eyesight. A large majority are troubled in some degree with defective vision. Tests have proved that these workers require considerably more light to give

Fig. 1—Foundry Illuminated by 300 Watt Lamps in Deep Bowl Porcelain Enameled Reflectors; Spacing Between Reflectors 30 Inches; Height 25 Feet. Localized Lighting Over Molding Benches One 40 Watt Lamp in Deep Bowl Reflector 11 Feet Above the Floor

Fig. 2—Standard Dome Reflector

the quickness of perception enjoyed by perfect eyes. This condition in almost all cases can be corrected or improved through the use of higher wattage lamps and often in conjunction with a carefully considered arrangement of fixtures. The recommended intensities for foundry operations are as follows:

Character of work	Foot-Candles Good Practice	Foot-Candles Minimum
Charging floor, tumbling, cleaning, pouring, shaking out	8	5
Rough molding, core making	10	6
Fine molding, core making	15	10

Nonuniformity of illumination is due largely to irregular spacing of the lighting units or to wide spacing with low mounting heights. In designing lighting installations there is a definite relationship between the mounting height or distance from the floor to the reflector and the distance between the reflectors. In the case of foundry installations, the spacing of the units should not exceed five-thirds of the mounting height. In other words, where the units are mounted nine feet above the floor the spacing should not exceed fifteen feet to obtain uniform illumination.

Avoid Shadows

Troublesome shadows are caused usually by the use of small intense light sources or light coming from a single direction. This condition may be avoided by locating properly the reflecting equipment. Gloom is due mainly to a combination of too little illumination, nonuniformity and shadows. It has a depressing effect upon the spirit of the workmen, tending to make them careless.

The methods of applying artificial illumination may be divided into three classes, according to the manner in which the lighting fixtures are located: general overhead lighting, localized general lighting and local lighting.

General overhead lighting consists of mounting the lighting equipment in a symmetrical arrangement over the entire working area. This method is applicable to most foundries and is the most economical system because relatively few outlets are required and the more highly efficient, larger size lamps can be used.

The localized general lighting consists of locating some of the lighting fixtures near work benches or machines where a higher intensity of light is required than that obtained from the overhead system. It is used in conjunction with the overhead or general lighting system. This system would be found useful in those foundries where fine bench molding is being performed.

Local lighting is used only where a high intensity over a small area is required. It finds little application in foundry lighting except where it is necessary to have light inside of a large mold. In this system of lighting care must be used to see that the light sources are shielded properly from the eyes of the workmen, or they become a serious source of glare. It should always be used in conjunction with a general overhead system. Wherever one of the other forms of lighting is applicable it should be used in preference to the local lighting.

The selection of suitable reflecting equipment is of the utmost importance in foundry lighting installations. The reflector is used to shield a bright light source from the eyes of the workman, and to increase the efficiency of the lighting installation by redirecting down onto the working plane the light which would otherwise be lost on the ceiling.

Needs Are Met

The essential requisites of a reflector for this class of service should be permanence, durability, efficiency and ease of maintenance. For this reason the metal reflectors having porcelain enameled or chromium plate for the reflecting surface are used most widely. Reflectors of these materials are made in a variety of shapes to meet various demands of light distribution. For general and localized general lighting, a dome as illustrated in Fig. 2 commonly is used. That type reflector has a desirable distribution of light over horizontal surfaces and is so designed that direct glare practically is eliminated. It is efficient and easily cleaned. For high mounting, such as, 40 feet or more, a reflector with a more concentrated distribution is desirable. For this purpose the deep bowl, high bay mounting reflectors, as illustrated in Fig. 3, made either of chromium plated metal or prismatic glass, are available. Angle reflectors are used where high illumination of vertical surfaces is required or where lighting units must be mounted along the walls, especially under the crane runways.

In many otherwise good foundry lighting installations too little attention is given to the capacity of circuits and the allowance for voltage drop. Wiring should be designed for not only the present wattage requirements but also should, in addition, have sufficient capacity for future increases of at least 50 per cent in the wattage used for lighting. Intensities which were considered adequate 5 years ago are now obsolete. It is safe to assume that, within another five years, as the public becomes further educated to the marked operating economies which may be affected by high intensity illumination, present day intensities will have been left far behind. In designing lighting circuits the size of the wire should be based upon the maximum capacity of the circuits and should be such that when all lamps are lighted, the voltage drop will be a minimum consistent with good practice. A socket voltage 5 per cent below the labeled lamp voltage results in a 16 per cent decrease in light output, while operation of a lamp 8 per cent below its rated voltage causes a 25 per cent reduction in light output. From this will be seen the advantage of having the lamp and the socket voltage in agreement.

Advantages Are Listed

The advantages of 115 volt over 230 volt service for lighting are: Decreased lamp cost, higher light output, better performance, larger number of standard types available, ease of obtaining replacements and lower cost of panel boards.

Lamps for 115 volt service cost approximately 20 per cent less than the same wattage lamps for 230 volt service, whereas the light output of the 115 volt lamp is 23 per cent higher than the 230 volt lamp of the same wattage. The performance of the 115 volt lamps is better since the diameter of the filament of a lamp of a given wattage in the 115 volt class is approximately twice that of the same size lamp in the 230 volt class. Therefore, the filament of the former lamp is more rugged and less likely to be broken.

The illumination obtained from a new lighting installation is 25 to 50

(*Concluded on Page* 89)

Fig. 3—Prismatic Reflector for High Mounting

GRAY IRON

Possesses

Valuable Engineering Properties

Part IX

IMPACT resistance of gray iron means its resistance to suddenly applied loading as under a shock or blow, as distinguished from resistance to slowly applied stress as used in the tensile strength determination. Higher impact strength implies toughness as opposed to brittleness.

Fatigue strength of gray iron is that stress value under an infinite cycle of loadings and unloadings, that is repetitions of stress, can be sustained without failure. The limiting fatigue strength for a given type of stress cycle often is known as the *endurance limit*. In the usual form of fatigue or endurance tests known as rotating beam tests, the specimen is subjected to alternating transverse stresses, the fibers thus being under alternate tension and compression, rather than under cycles of repetition of tensile stress and release of load. In simple terms the endurance limit is that limiting cycle of stress up to which the material can withstand vibration for an infinite, or at least an indefinite period.

Shocks Occur in Use

In engineering service resistance to shock and vibration certainly is as important as resistance to dead load. As a matter of fact dead loads, and slowly applied loads are the exception rather than the rule. Nearly all types of gears are subjected to shocks. Pipe lines and valves have to stand water hammer and pressure surges. Lugs on automotive cylinder blocks have to resist a great deal of vibration, and so on. So gray iron must possess resistance to shock and vibration as well as sufficient static strength.

When gray iron is hit hard enough, it breaks without bending. It is not subject to marked deformation. Therefore, it would be easy to conclude from superficial consideration that its resistance to shock and vibration is negligible and its applications limited. Yet a wealth of everyday experience shows that this is not the case. Cannons made from gray iron withstood the severe shocks of repeated firing, and automobile pistons resist the impact from repeated detonations without breaking.

While recently considerable has been found out about the fatigue resistance of gray iron, relatively little is known about its impact resistance. As a rule higher strength irons possess greater impact resistance, although their ductility as measured in tension, or their deflection as measured in transverse testing generally is lower than that of weaker irons. That is shown by the following examples: Iron No. 1, cast into a 1-inch diameter bar had a tensile strength of 21,744 pounds per square inch, whereas Iron No. 2 had a tensile of 34,575 pounds per square inch. On a drop test with supports 5 inches apart and a 20-pound weight, starting both specimens at the same point and advancing the height drop in equal increments, No. 1 broke on the 6-inch drop whereas No. 2 broke at 7½ inches. The energy indicated in the final drops is proportional to the square of the heights since $F = MA$, and A is proportional to $\frac{1}{2}gh^2$. Thus the proportionality of No. 1 to No. 2 is as 1 to 1.56. The tensiles are 21,744 to 34,575 or 1 to 1 58, which happens to be nearly the same ratio.

Results Favorable

IN ENGINEERING service gray iron castings usually are subjected to shock and vibration. While many conclude from superficial considerations that gray iron has negligible resistance to shock and vibration, every day experience refutes such statements. Investigations on fatigue resistance show that gray iron compares favorably with more ductile materials as is explained in this article, which is the ninth of a series. The eighth article appeared in the Sept. 1 issue.

In the common drop test the sample is supported on knife edges in a manner similar to that employed in the transverse test. The knife edges usually are from 4 to 7 inches apart. A weight with a central knife edge is dropped upon the specimen so that the knife edge hits centrally between the two supports and parallel to them. The weight is dropped from a certain height above the specimen, and is dropped repeatedly from increasing height until the specimen breaks. There is no standard method of conducting this test, nor a satisfactory method of expressing the results in intelligible units. It is not surprising then that no conclusive or comparable results have been obtained from this test.

Manufacturers of chilled car wheels have a standard drop test which is described in Specification A46-24 of the American Society for Testing Materials. In this test the wheel is supported at three points and a cylindrical weight dropped flat face down upon the hub of the wheel.

Testing Machines Are Used

The Izod and Charpy impact testing machines are widely used for testing various metals, particularly steel. These machines consist essentially of a pendulum swinging from a known height. At the bottom of the swing the pendulum strikes the test piece which is securely clamped in the anvil of the machine. The test piece usually is notched to insure fracture in ductile materials. The resistance offered by the specimen to the swing of the pendulum reduces the momentum of the latter. The energy absorbed in this manner is measured by suitable devices.

In addition to the machines mentioned a number of other devices have been employed from time to time in the testing of impact value of gray iron. None of the machines have been accepted as suitable by testing engineers and published tests are too meager and inconsistent to merit extended exposition at this time. Leading testing societies are giving these matters serious consideration and there is good reason to hope that there will be much enlightenment within the next few years.

With present knowledge of the structural features of gray iron, our knowledge of the behavior of other materials under impact tests, and engineering experience with gray irons, it seems possible to indicate qualitatively the probable behavior of various types.

The major reason that the impact value of gray iron is low is the presence of weak graphite flakes. These flakes possess little tenacity and afford easy paths for rupture, as explained previously in the discussion on

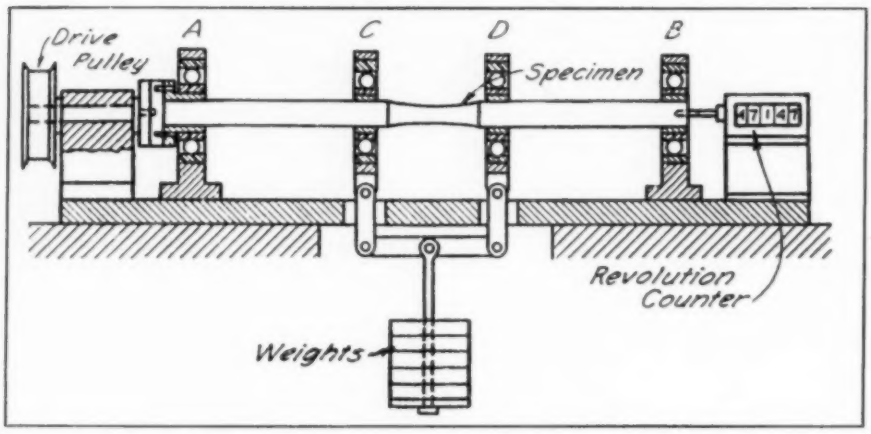


Fig. 60—Sketch Showing the Principal Parts of the Rotating Beam Testing Machine and the Position of the Specimen

microstructure. The more nearly continuous these areas of weakness are along the planes of stress, the less amount of metallic matrix intervening to resist stresses. In a weak, open-grained iron the flakes are many, large, and close together. Therefore such metal is weak and brittle. When gray iron is highest in total carbon it has more graphite, providing the combined carbon is held constant. Therefore, other factors equal, lower total carbon usually indicates higher shock resistance properties.

Graphite Influence Modified

While the amount, distribution, and size of graphite flakes has an important influence on the impact resistance of gray iron, this influence is modified, often materially so, by the nature of the metallic matrix which is composed of pearlite, ferrite and steadite. Steadite, the phosphorus rich component, is extremely brittle. When present in sufficient amount it forms nearly continuous networks in the metal. As a result the general rule is that high phosphorus irons are markedly brittle and have little impact resistance. While there are exceptions, most gray iron castings used for more severe services have low phosphorus contents usually from 0.20 to 0.40 per cent. Practically all the high test irons made today are in the lower phosphorus range.

Ferrite, structurally pure iron, is quite ductile. However, the ferrite in gray iron contains substantial amounts of silicon and other elements in solid solution, hence is less ductile than the forms of ferrite found in low carbon steels. In addition, in a gray iron of given carbon content, increase in ferrite (at the expense of pearlite) indicates a greater amount of free or graphitic carbon.

Pearlite is not nearly as ductile as ferrite, but as just explained, decomposition of pearlite to ferrite and graphite increases the amounts of the embrittling component graphite as well as of the more ductile component ferrite. The net effect cannot be predicted with any degree of accuracy. It is to be hoped that much needed research will indicate the net effects which probably will vary greatly in various cases and over various ranges.

Impact resistance represents energy absorbed. In the pendulum type impact test, for example, the impact value is computed from the potential energy of the swinging pendulum minus the actual energy measured after rupture has been effected. A body is said to possess energy when it can do work. Since action and reaction are equal and opposite, the energy absorbed by the test piece equals that expended by the pendulum. Therefore, the test piece must do work. The work done can be measured by the force or stress (F) multiplied by the distance (S) through which the force moves. That is to say work $= FS$. Energy is expressed in the same units as work.

In a tensile test, for example, an increased stress causes an increased stretch or strain or elongation. The work done, FS, is the product of the stress and strain. Referring to the stress-strain diagram, it is readily apparent that the area under the curve represents work, the summation of products of stress and strain for the series of loadings. Thus in both impact test and tensile test, the test piece does work in resisting and being deflected by stresses applied, whether these be under kinetic conditions, as in impact tests, or (relatively) static as in the tensile test.

Since both conditions represent work done on and by similar test pieces (for a given iron), it is logical to expect similar work capacities. As a matter of fact careful experiments on certain materials, particularly on steel, show that impact and tensile resistances are quite similar when translated into work units. However the work capacity values as measured in impact were found to be higher than those measured in the more static form of test. An explanation advanced is that in the impact test the total energy is partially dissipated due to vibrations set up in the testing machine, momentary deflection of the anvil, etc.

Resistance Is Equal

An interesting conclusion which may be derived is that the impact value of cast iron is proportional to the work under the stress-strain diagram. Experience shows this to be the case. Even the hammer test reveals the greater impact or shock resistance of the high test iron, and the area under the stress-strain curve obviously is greater than for the weaker and more brittle metal as may be seen by referring to Sections IV and V. Another interesting thing is revealed,

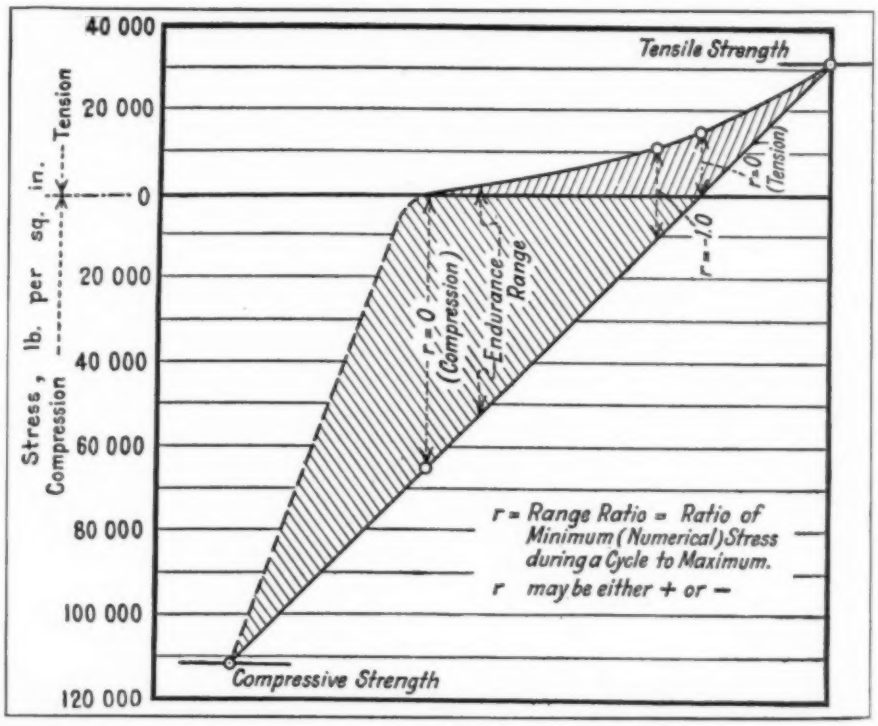


Fig. 61—Varying Endurance Limits of Cast Iron with Varying Range of Stress

in that the fallacy of assuming greater ductility alone is a necessary implication of greater impact resistance. The ultimate ductility of high test iron often is less, yet the summation of products of stress and strain (or ductility per stress) is greater.

From this it would appear that even the simple transverse test can be utilized to indicate approximate impact resistance. The product of breaking load and ultimate deflection gives a relative approximation of the area under the curve. Experience indicates that this too is a pretty fair indicator, but of course not an accurate one, since the stress-strain diagram under transverse loading is a curve, not a line. The embrittling effect of phosphorus is well shown by the transverse test; higher phosphorus usually slightly lowering the strength and diminishing the deflection at ultimate load for given silicon and carbon content.

Carbon and Phosphorus Lowered

For higher impact resistance lowering the carbon and phosphorus are advantageous. The net effects of changing the relative amounts of pearlite and ferrite must be established clearly through research. The relation of impact resistance to the area under the stress-strain tensile test and transverse test diagrams probably will afford a method of evaluating impact resistance from tensile or transverse tests.

While some of the earliest work on effect of repeated stresses on cast iron was done in England about 1860, the first really systematic investigations on which many of our present day testing methods are based, namely the work of Wohler, neglect the fatigue testing of cast iron. Apparently the only significant work done on fatigue testing of cast iron has been done by Moore, Kommers, and Lyon. Their work is confined to examination of 14 specimens, four tested by Moore and Lyon, and ten by Kommers. Recently at the meeting of the American Society for Testing Materials held in June, 1930, Kommers presented a paper on "The Effect of Understressing on Cast Iron and Open-hearth Iron."

Testing machines for making fatigue tests may be classified according to the type of stress produced as follows:

(1) Cycles of axial stress, (a) alternate tension and compression, (b) alternate tension to zero stress, (c) alternate compression to zero stress; (2) cycles of flexure employing the so-called rotating beam test machine illustrated in Fig. 60. This is the type apparatus employed by Moore, Lyon and Kommers, and (3) cycles of torsion or alternate twisting stresses.

Deterioration in fatigue is progressive in nature, much more gradual than failure in tension of a ductile material. Under a sufficiently large number of restressings, incipient fractures are started in small flaws, since the latter allow increased localized stress intensity, the start of cracks, and the gradual progress of fracture from these points. In ductile materials fracture in tension tests is preceded by preceptible flow, elongation, and reduction of cross sectional area. In these same materials fatigue failure may be sudden as the repetitions of stress produce a condition of affairs that causes sudden *brittle-acting* failure, with no stretch or elongation to give warning of impending fracture, excepting possible visible cracks.

Griffith believes that the weakness of ordinary solids is due to discontinuities and flaws whose ruling dimensions are large when compared with atomic distances. It is well known that the calculated absolute atomic cohesions of metals are of an order of magnitude far greater than the apparent cohesions in test pieces. Yet investigators have shown by high power microscopy that these flaws (if they exist) are not detected with the best lenses.

Moreover the strength of microscopically sound metal is found to be uniform and reliable. Yet a piece of gray iron is full of discontinuities (the graphite flakes). It is brittle, and its internal structure is popularly conceived as inadjustable. Can we then expect any real stress resistance, either on long time static tests or on alternating stress (fatigue) tests where the cycles run 10,000,000 or more reversals of stress. Experience answers the first question. Fatigue tests indicate the answer to the latter.

Results Are Favorable

Summarized briefly, fatigue tests show:

(1) That the endurance limit of gray iron is about half the ultimate tensile strength when the test piece is protected from external vibrations. This compares favorably with the ratio of wrought steels (usually given as half the ultimate tensile strength) and of cast steel (given as 0.40 × the ultimate tensile strength.) A corollary is that gray iron is a reliable engineering material if proper grades are chosen, design is logical and workmanship good.

(2) The values for endurance limit are not reduced greatly up to temperatures of 800 degrees Fahr. above which fears of growth phenomena insure that few engineers are going to try to employ gray iron extensively. Above 1250 degrees Fahr. the endurance limit is as high as the tensile strength under prolonged steady load.

(3) Tests on range of stress indicate that endurance limit from stresses from zero to a maximum tension are about one and one-half times the limit for completely reversed flexural stress, that is alternate tension and compression in the flexed rotating beam. Kommers shows this in an ingenious chart shown in Fig. 61. In the *Proceedings* of the American Society for Testing Materials, 1929, he states:

"Fig. 61 shows the results obtained when fatigue tests were made using various combinations of tension and compression in the cycle of applied stress. When the unit stress was entirely compressive from zero to a maximum ($r = 0$), the endurance range was 65,000 pounds per square inch representing the endurance limit in compression. When a small amount of tension was introduced into the cycle the endurance range was reduced at once. For example, at 6400 pounds per square inch tensile stress in the cycle the endurance range becomes 38,400 pounds per square inch. For completely reversed stress, that is tensile stress equal to compressive stress ($r = -1$), the endurance range is reduced to 21,000 pounds per square inch, the endurance limit being 10,500 pounds per square inch. Finally, when the unit stress was entirely tensile from zero to a maximum ($r = 0$), the endurance range was smallest of all, being only 15,500 pounds per square inch, corresponding to the endurance limit in tension.

Failure Is Produced

"The endurance range, therefore, in these tests varied from 65,000 pounds per square inch when the stress was entirely compressive, to 15,500 pounds per square inch when the stress was entirely tensile. It is evident that for cast iron, tensile stress is especially effective in producing fatigue failure."

(4) The effects of stress raisers (such as holes and grooves) on endurance limit of gray iron are relatively less important than similar accidental or induced imperfections on heat-treated steels.

(5) An interesting comment by the investigators, is stated by Kommers as follows "—so long as these (internal) deformations do not exceed a certain amount the material can adjust itself to the deformations, and after a sufficient number of cycles of stress the permanent deformations cease to increase. The material then will be perfectly elastic within the range of the applied stress." This substantiates similar conclusions drawn on the elastic nature of gray iron under tensile stresses as mentioned in Section V on the elastic properties of gray iron.

Moore and Lyon found it possible to increase the endurance limit by oft repeated stresses below the normal endurance limit. Later investigations by Kommers, *Proceedings* of the American Society for Testing Materials, 1930, show that by understressing cast iron at a stress just under the ordinary endurance limit, a new endurance limit higher than before will be established. The new endurance limit shows a maximum of 31 per cent above the ordinary limit. Understressing was applied for 15,000,000 cycles or over. Kommers also found that the effects of notches as stress raisers in gray cast iron were negligible whereas in the case of ductile metals, the notch effect was serious.

Fig. 1—Metal Melted in the Large Furnaces is Held in the Holding Pots Until Poured in the Permanent Molds

Aluminum Kitchenware Is Cast *in Permanent Molds*

By J. B. Nealey

PRESENT day practice in producing castings from aluminum and aluminum alloys is divided into three principal methods, known as sand casting, permanent mold and die casting. When large numbers of identical parts are wanted which require definite physical characteristics, a smooth finish and a high coefficient of heat conductivity, either permanent mold or die casting processes often are used. With the permanent mold method of casting, alloys of copper brass, etc., which melt in the neighborhood of 2000 degrees Fahr. may be used.

The Monarch Aluminum Ware Co., Detroit, produces a general line of aluminum and other alloy castings in the form of household cooking utensils, and parts for motors, automobiles, airplanes, washing machines, toasters, irons, waffle irons, etc. The permanent mold method is employed most extensively in this plant, although sand casting is used when more economical.

Castings with almost any combination of physical properties are made at this plant from alloys used, mostly aluminum. For example, aluminum with small percentages of copper, silicon, iron, magnesium, or tin, produces castings with tensile strengths varying from 18,000 to 30,000 pounds per square inch and with elongation percentages in 2 inches running up as high as 10 per cent. If heat treated the tensiles run between 24,000 and 55,000 pounds per square inch.

One of the most commonly used alloys contains 92 per cent aluminum and 8 per cent copper and, when poured, develops a tensile strength of 18,000 to 20,000 pounds per square inch, a yield point of around 16,000 pounds per square inch and an elongation of from 2 to 5 per cent. Another contains 95 per cent aluminum, and 5 per cent silicon with a resulting tensile of about 24,000 pounds per square inch, a yield point of 17,000-18,000 pounds per square inch and an elongation of 4 to 5 per cent. Still another, and one of the toughest, consists of an aluminum base with nickel, magnesium or manganese. Castings made from these, when heat treated, develop tensile strengths ranging from 35,000 to 40,000 pounds per square inch. By slightly varying the small percentages of alloying metals, a wide range in physical characteristics can be obtained.

Fig. 2—Large Revolving Type Furnace Used in Melting

The molds are semisteel castings made in two or more parts, which, when held together, form the shape of the casting to be made. These parts are held in a mechanical device within a frame which operates through cams, link motions, rack and pinions, etc., to force and clamp them together during pouring and pull then apart to allow the casting to drop out. The latter motion includes drawing the cores. When a new job is introduced a whole new machine is built for it. These machines are hand operated.

Alloys are melted in regular melting furnaces. The molten metal is transferred to holding furnaces or crucibles and is poured from these

into the molds with hand ladles. Gas is the fuel employed in melting the alloys. As the pouring temperature of the metal increases the rate of freezing becomes slower and the crystal or grain size becomes larger. This causes a progressive decline in the physical characteristics of the resulting casting. If the temperature is too high, burning takes place. Hence, pouring temperatures are narrowed down to the lower limit of the melting range which calls for close temperature control.

Several types of melting furnaces are used in this plant, the most common being a cylindrical oscillating type consisting of a steel retort that is lined with refractory material, which is set in a suitable frame. The furnace chamber or retort is made of steel plate with cast iron heads and a cast-steel collar around the pouring opening. A refractory lined, cast-iron door, with a vent hole, clamps tightly down on the steel collar when the furnace is in operation. This retort rests on cast-iron stands bolted to a heavy bed plate, and revolves on steel rollers by a worm and gear, motor operated.

Retort Is Split

The retort is split longitudinally, hinged at the back and held together with bolts so that it can be relined with the greatest ease. It is heated directly with a gas burner firing into it through one end. The melting speed is increased by rotating the furnace through 180 degrees or nearly to the pouring point, as soon as it is lighted up, allowing it to remain in this position for 15

Fig. 3 — Each Furnace Melts 300 Pounds of Metal

minutes and then rotating it to the opposite side a similar amount and for a similar period. This oscillating motion is continued until the metal is ready. Each of these furnaces are of 2000 pounds capacity.

The holding furnaces consist of upright steel shells, brick lined, in which crucibles are held. The firing system consists of a single gas burner, located at the bottom, the flame impinging on the crucible tangentially. The metal in these crucibles, which are of 400 pounds capacity each, is maintained at the correct pouring temperature by thermocouples and automatic temperature controls.

Some of the castings produced in this plant are annealed, others are heat treated but all pass through the machine shops where are located batteries of band saws for gates and risers, grinders, etc. and rows of lathes, drill presses, tapping machines, polishers, buffers, etc. Final cleaning is accomplished in a washing machine consisting of a rectangular steel shell equipped with a traveling conveyor of steel mesh. A series of nozzles through which hot washing solutions are forced in needle sprays are located in the first part of this machine while a row of gas burners transform the latter portion into a drying oven.

Physical Properties Increase

Gas fired furnaces also are used for annealing and heat treating. For removing casting strains the parts are heated in an oven to 280 degrees Fahr. and allowed to cool slowly with the oven. The heat treatment of these castings consists of heating to the required temperatures and quenching in boiling water, cold water or oil and aging in air. The temperatures used vary from 920 to 980 degrees Fahr., according to the chemical analysis of the metal included in the casting.

When quenched the material is almost as soft as when in the annealed state but increases in hardness and strength (tensile and yield point) when allowed to stand at room temperature. While this aging action is rapid at first it slows down gradually, being completed in from 4 to 10 days. There is little or no loss in elongation but there is a decided decrease in plasticity. Some alloys require a second heating and quenching to get the maximum effects while others age spontaneously

(*Concluded on Page* 89)

Fig. 4—Semisteel Molds Are Mounted on a Special Type of Machine

Standardized Cost Systems

Must Be Applied Uniformly

By A. C. Denison

A GOOD cost system will be of the greatest value when the method for using cost figures will be applied in a uniform manner by competing foundrymen. This fact can easily be substantiated, for example, by considering a few ways of arriving at the value of the cleaning department costs.

Among these various ways of prorating cleaning costs, three methods have recently come to the authors attention:

a. Cleaning department costs are prorated against direct molding and coremaking labor, or so much per dollar of direct molding and coremaking expense.
b. Cleaning department costs are prorated against tonnage, or so much per pound of good castings.
c. Cleaning department is considered as a distinctive operating department and direct cleaning costs are procured.

The third method will, the author believes, be accepted readily by foundrymen as the most accurate as it carries the cost direct to the specific operation. Practical examples will clearly show that the first two methods result in wide variations in estimates on castings involving extreme cases of plain or intricate work, and proportional variations between such extreme cases.

The several different ways of using carefully computed cost figures leads to a bad situation within our industry, and places competing foundrymen at the mercy of shrewd casting buyers. Oftentimes the efficiently and economically operated foundry which should benefit from its low production costs is compelled to estimate high on some types of work merely because it is using an incorrect method for arriving at its final cost figures.

Foundry *A* estimates its cleaning and shipping cost on a pound basis. Foundry *B* estimates its costs on a molding and core direct (productive) labor basis. Both bid on a plain heavy casting and a light intricately cored and molded castings. Foundry *A's* estimate will be high on the plain casting and exceedingly low on the intricate casting. Foundry *B* will be low on the plain and high on the intricate casting. Actually, both foundries will have approximately the same cleaning and shipping costs. Shrewd purchasing agents can analyze easily the variations in estimates and, naturally, will divide the work and give it to the respective low bidders. As a consequence, both foundries fail to make a normal profit, or run at a loss and wonder why, while the buyer has earned a dividend for his company at the expense of both of the foundries.

WHILE a uniform cost system is of major importance to an industry, the intelligent application of the system to a particular company is vital if the company is to operate profitably. This article points out the startling discrepancies that may exist in extreme cases where different methods are used to apply the cost information. The author of this article is president and treasurer Fulton Foundry & Machine Co., Cleveland. He has taken an active interest in various foundry groups, including the Gray Iron institute and the Ohio Foundries association. At present he is chairman, Cleveland district chapter, Gray Iron institute.

To further illustrate the seriousness of this situation, the following comparative figures are presented. Consider a foundry that has a good cost system which over a period of time establishes the following average operating costs:

1000 pounds of good castings produced.

		Cost per 1000 pounds
Cupola or melting department: Cost of material, labor, supplies, miscellaneous expenses, and share of general overhead		$14.00
Molding department:		
Molding and helpers labor (8 hour)	$ 8.00	
Indirect labor	6.40	
Miscellaneous expenses	3.60	
Miscellaneous materials	3.60	
Share of general overhead	2.40	
	24.00	24.00
Core department: direct labor (2 hours)	2.00	
Indirect labor	1.60	
Miscellaneous expense..	1.00	
Miscellaneous material	1.00	
Share of general overhead	.40	
	6.00	6.00
Cleaning and shipping:		
Direct labor (5 hrs.)	2.50	
Miscellaneous expenses..	.30	
Miscellaneous materials	.30	
Share of general overhead	.40	
	3.50	3.50
Total cost		$47.50

Interesting results may be obtained by applying different methods in using these operating costs in estimating two specific jobs.

Job *A*—An intricately cored and skillfully molded casting weighing 300 pounds such as a jacketed cylinder, requires 8 hours of molding labor, 4 hours of core labor and 3 hours of cleaning labor.

Job *B*—A plain bolster plate with a few simple cored holes, weight 3000 pounds requires 8 hours of molding labor, 1 hour of core labor and 5

hours labor for cleaning and shipping.

Case 1. In making this estimate, molding and coremaking costs are considered as direct labor. All molding and coremaking indirect costs are considered as direct labor expenses respectively, and the cleaning cost is considered as a prorate to this total direct molding and coremaking cost.

The estimating formula is as follows:

$$\text{Molding cost} = \text{hours molding} \times 3.00$$

$$\text{Cost cost} = \text{hours coremaking} \times 3.00$$

$$\text{Cleaning and shipping cost} = (\text{hours molding} + \text{hours coremaking}) \times \frac{3.50}{10}$$

$$\text{Iron cost} = \text{weight} \times 1.4$$

The factor used in obtaining the cleaning and shipping cost is secured by dividing the cleaning and shipping cost, previously shown as $3.50, by 10, the total hours of molding and coremaking labor.

Figuring job *A*, the 300-pound casting will cost $44.40 or 14.80 cents per pound.

Figuring job *B*, the 3000-pound casting will cost $72.15 or 2.40 cents per pound.

Case 2. In this estimate, molding and coremaking are considered as direct labor. All molding and coremaking indirect costs are considered as direct labor expenses respectively, but the cleaning cost is considered as a prorate to tonnage, or so much per pound.

The estimating formula then is as follows:

$$\text{Molding cost} = \text{hours molding} \times 3.00$$

$$\text{Cost cost} = \text{hours coremaking} \times 3.00$$

$$\text{Cleaning and shipping cost} = \text{weight of iron} \times \frac{3.50}{1000}$$

$$\text{Iron} = \text{weight} \times 1.4$$

Figuring job *A*, the 300-pound casting now costs $41.25 or 13.75 cents per pound.

Figuring job *B*, the 3000-pound casting now costs $79.50 or 2.65 cents per pound.

Case 3. In this estimate, molding, coremaking, and the department indirect costs are used as in cases 1 and 2. The cleaning cost, however is used as a direct cost, or so much per hour cleaning time.

The estimating formula then is as follows:

$$\text{Molding cost} = \text{hours molding} \times 3.00$$

$$\text{Cost cost} = \text{hours coremaking} \times 3.00$$

$$\text{Cleaning and shipping cost} = \text{hours cleaning} \times \frac{3.50}{5}$$

$$\text{Iron cost} = \text{weight} \times 1.4$$

Figuring job *A*, the 300-pound casting will cost $42.30 or 14.10 cents per pound.

Figuring job *B*, the 3000-pound casting will cost $72.50 or 2.42 cents per pound.

Case 4. In this estimate, the items of miscellaneous material cost in the molding department are considered a tonnage cost. In the core room, all indirect costs are used on a direct core labor basis. In the cleaning and shipping, a direct cost of so much per hour is used.

The estimating formula then is as follows:

$$\text{Molding cost} = \text{hours molding} \times \frac{20.40}{8}$$

$$\text{Cost cost} = \text{hours coremaking} \times 3.00$$

$$\text{Cleaning and shipping cost} = \text{hours cleaning} \times \frac{3.50}{5}$$

$$\text{Iron cost} = \text{weight} \times 1.40$$

$$\text{Iron expense burden} = \text{weight} \times \frac{3.60}{1000}$$

Figuring job *A*, the 300-pound casting will cost $39.78 or 13.26 cents per pound.

Figuring job *B*, the 3000-pound casting will cost $79.50 or 2.65 cents per pound.

SUMMARY OF ESTIMATES

	Job *A*	Job *B*
	Cost, cents per pound	
Case 1	14.80	2.40
Case 2	13.75	2.65
Case 3	14.10	2.42
Case 4	13.26	2.65

It is apparent from a study of this summary how several foundries could operate in the same city at the same efficiency, how each could use a different method of applying its costs, and how the various plants would wreck themselves in normal competition with one another. This in general is what the author believes the foundries are doing today and it explains in a large way the present unhappy condition of the industry.

Therefore, it seems that the logical solution of the situation is the adoption among foundries of a uniform method of applying costs.

CorrectFoundryLighting Increases Efficiency

(*Concluded from Page* 82)

per cent higher than the average to be expected from the same installation after it has been in service for a time. This reduction in illumination is due to the unavoidable collection of dirt upon the lamp and reflector equipment. It is not feasible to maintain the lighting equipment at all times as clean as when the original installation was made, but on the other hand, it is not economical to allow this dirt accumulation to decrease the illumination below a productive level. In the average foundry interior it is essential that the lighting equipment be cleaned with a dry cloth at least every two or three weeks. At about every third cleaning, it should be washed thoroughly with soap and water, using about one-half pint of household ammonia to every 4 gallons of water. After being washed in this solution the equipment should be rinsed and dried thoroughly. Lamp bases should not be immersed.

Foundry lighting installations often are looked upon as a necessary and expensive evil and rightfully so if the system is installed in a haphazard manner. However, if it is properly planned, installed and maintained it will prove an asset and become an investment bringing in dividends.

Kitchenware Is Cast in Permanent Molds

(*Concluded from Page* 87)

at room temperature. Hot air blast or steam sometimes is used in the place of water for quenching.

After the material has been brought up to temperature for heat treating (920-980 degrees Fahr.) it must be soaked for time periods varying all the way up to 12 hours before quenching. This, of course, varies according to cross section of the casting, chemical analysis of the material and physical properties desired. Here again absolute temperture control is essential, for if the heat is too low the effects desired will not be obtained and if too high partial melting and burning together with loss in strength and ductility will follow. It is also necessary to reduce the time period between the furnace and the quenching medium to the absolute minimum.

Nominating Committee Is Appointed

Gray Iron institute, Terminal Tower building, Cleveland, has appointed the following nominating committee to select the nominees for six directors, five for three-year terms and the other for the one-year term to fill a vacancy left last year at the suggestion of the second annual meeting: Ray Redmond, Buckeye Foundry Co., Cincinnati, chairman; J. George Lehman, Bethlehem Foundry & Machine Co., Bethlehem, Pa.; Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; Ellis Rogers, Rogers Iron Works Co., Joplin, Mo.; and J. Rowbottom, Diversey Foundry Co., Chicago. The five directors whose terms expire at the time of the annual meeting are: J. H. Bruce, Bowler Foundry Co., Cleveland; H. S. Chafee, Builders Iron Foundry, Providence, R. I.; A. E. Clarke, Des Plaines Foundry Co., Des Plains, Ill.; Fred Erb, Erb-Joyce Foundry Co., Detroit; and Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Plate Warps in Cooling

QUESTION

We are having trouble with a curved liner plate 21 inches wide, 54 inches in length and ¾-inch thickness of metal. The casting is made from white iron and the mold is poured with the crown side in the cope. In cooling, the casting develops a pronounced bow with the ends higher than the center. We have tried every method with which we are familiar to prevent the casting from warping, but without success.

ANSWER

Since you are a practical man and have tried all the usual methods to prevent the casting from warping we hesitate to offer an opinion without further details. For example you do not state how the casting was gated, the depth of sand in the cope and drag, how the casting was shaken out or how soon you commenced to strip certain parts after the metal had set. All these factors must be taken into account. A plain, flat plate cast in open sand is held flat and straight by the simple expedient of leaving the center uncovered and piling sand over the two ends. On a wide plate this practice is elaborated by covering the plate with sand, baring the center and then stripping diagonal passages from opposite corners.

Offhand we are inclined to the opinion that stripping the center on the cope side of your plate immediately after it has set, should be sufficient. The cope should be well rapped before it is removed so that all or nearly all of the sand remains on the casting to conserve the heat at the ends. The casting should be poured from both ends for the same reason. The theory is that if the skin is cooled rapidly in the center it will not *pull* the ends later.

The fact that your casting is curved laterally and the further fact that it is poured with white iron probably account for the fact that ordinary methods are not satisfactory. As an alternative method you might roll the entire mold over immediately after it is poured and then strip the lower side of the casting. Another method, one that occasionally is practiced on castings that defy all ordinary anti-warp precautions, is to shake the casting out immediately after it has been poured and either suspend or support it on edge.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Specifications Desired

QUESTION

We are seeking some information on specifications and grading of sand for sandblast and core purposes. Have you any data on this subject?

ANSWER

As far as we are aware there are no standard specifications for core sand or for sandblast sand. Perhaps a few firms do have specifications for these materials but they are such as have been developed in their own plants and fit their own requirements. In core sand for example, the fineness cleanliness, freedom from clay, and minimum amounts of low fusion point materials such as feldspar mica, lime, etc. which could be stated in terms of Al_2O_3, FeO, CaO, etc., could be specified. Fineness could be determined according to the method advocated by the American Foundrymen's association. Cleanliness could be determined by visual examination and observing the amount of twigs, roots, leaves, and surface soil, etc. Clay would show up in visual and in chemical examination. Moisture also could be specified.

Perhaps the best way to establish a specification for sandblasting sand would be to try sands of varying fineness from different makers, and then pick the ones that give the best results. A fineness determination then could be run on these and made a part of the specification. Another point that might be considered is the friability of the sand. If it breaks up into dust easily, it will be more expensive than another sand that resists the breaking. However, we do not know of any way to determine this except by computing the amount of sand used per ton of castings.

Q & A

Castings Vary in Weight

QUESTION

Some of our gasoline pump castings are made in snap flask molds protected by steel bands and rammed on air squeezers. Other castings are made in molds that are hand rammed on the bench, the floor or on rollover machines. What weight variation generally is allowed in iron, brass and aluminum castings made under conditions similar to the foregoing.

ANSWER

With the exception of those for pipe no standards have been adopted on the subject of casting weight variation and in the great majority of cases it is not a factor of any importance. If a customer orders—say—100 castings, the foundryman weighs half a dozen to strike an average weight and then makes out his invoice accordingly. He may weigh the entire number, if they

are small and thus secure the weight (average) of each casting. Under a continuation of the same operating conditions, the average weight of the same castings will not vary. On the small castings to which you refer, particularly those in which the molds are squeezed on machines, the weight of individual castings should not vary more than 1 or 2 per cent.

Small castings molded in flasks on the floor may show a variation of 5 per cent, depending on the training and skill of the molder in ramming the sand and in pouring the metal. On larger castings where the element of strain may be introduced by weak flasks, soft ramming, hard pouring, or high heads, the variation may run to 10 per cent. Although never officially adopted as a standard, a tacit understanding prevails to the effect that castings are satisfactory so long as they do not exceed 10 per cent above the anticipated or accepted weight. Standard pipe probably is made under the most ideal conditions to insure uniformity, and yet according to a standard adopted by the American Society for Testing Materials, a variation in weight is allowed not to exceed 5 per cent above or below a definite weight for each size pipe. On special castings a variation of 10 per cent above or below is allowed on pipes 12 inches or less in diameter and 8 per cent on pipe above that size.

Q & A

Blows Cause Trouble

QUESTION

We are having trouble with some cast iron rolls we are making, and I am sending you two samples of these rolls for diagnosis.

ANSWER

The two samples that you sent are from hollow rolls, one having a thickness of 5/16-inch and the other 7/16-inch. Both samples contain a number of holes and porous appearing spots which at first observation appear to be caused by agitation of the metal just as it is freezing. This impression is verified upon a closed examination of the thicker-sectioned piece of roll. Under an ordinary magnifying glass, particles of sand plainly can be seen imbedded in the porous part.

Conditions of this type may be caused either by kick backs from the core or from the mold. The cause of trouble in the heavier roll probably is due to the mold being a little wet at some point adjacent to the holes. When the molten metal touched the wet sand a boiling action resulted which cut into the sand and allowed some of the sand particles to be imbedded in the iron. In the thinner roll the cause is not so evident and might be caused from hard ramming of the mold or poor venting of the core or a combination of both. Any of these conditions will allow pockets of gas to collect and when the metal strikes them the gas seeks an exit following the easiest course which is through the molten metal.

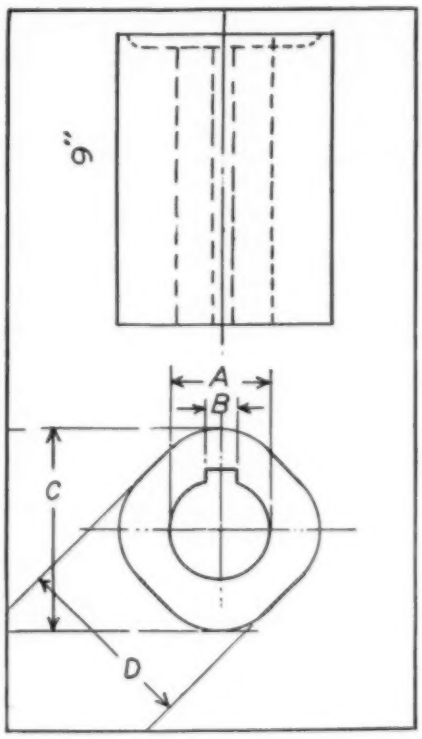
If the metal could stay liquid for a period long enough to allow the gases to pass through, no damage would be done. However, the metal begins to freeze while the gas is passing through, and results in a collection of holes which show the pathway sought by the gases in their efforts to escape.

GRAY IRON

To Make Cam Chills

QUESTION

We want to make a line of cast iron chills, cylindrical on the outside and shaped on the inside to form various sizes of screen cams, similar in a general way to the cam shown in the acompanying illustration. Is it possible to use



Dimensions C and D Vary According to the Throw Desired

a section of a steel shaft to form the opening in the chill. Do you know of any wash that might be applied to the shaft to enable us to drive it out of the casting?

ANSWER

We do not think your plan is feasible for the following reasons: Irrespective of what coating is employed on the steel shaft, the chill will contract to such an extent that the entire assembly will have to be placed in a hydraulic press to force out the shaft. In a majority of instances this will cause the casting to crack. The castings which survive this treatment will be in a state of tension on account of having their normal contraction prevented to some extent by the steel shaft. The first time they are employed as chills the sudden strain imposed by the hot iron will cause them to crack. The instance to which you refer in which a 1-inch steel core was employed successfully, does not furnish a precedent. In the first place the contraction around a 1-inch core is negligible. In the second place these cores are used only in comparatively short sections of metal. In the third place—and this is the most important—the opening left by the steel core was not used as a mold to be filled later with molten iron. However, if you intend to go forward with the experiment, you can get a special wash from one of the foundry supply houses, designed especially for use with steel cores. It is used quite extensively, but so far as we know, not on jobs of the size you contemplate. Nice, accurately made, well blacked cores will serve your purpose. Make them in a split box that can be opened and removed from the core standing on a plate without any rapping.

Q & A

Handle Does Not Hold

QUESTION

We are trying to cast a gray iron handle on a brass rod, but the rod will not fit tightly in the handle, and there is a blowhole on the top of the casting. We can cast gray iron handles on steel rods with little difficulty, but are unable to cast iron around brass. The brass rods are cleaned thoroughly with distillate, wiped dry and then oiled with a medium heavy oil. We pour the iron hot and slowly to allow the gases to escape.

ANSWER

The process you mention generally is reversed in foundry practice with the brass being cast around the iron. Exercising sufficient precaution this seems to work out satisfactorily. The iron must be perfectly clean and heated quite hot before the brass is poured around it. In the case of steel and iron, the process is not so difficult because under the proper conditions, the iron and steel fuse together and form a good joint.

With brass and iron there is no possibility of fusing or uniting as they are dissimilar metals. Consequently, the solid contraction of the metals after heating must be relied upon to supply the required tightness of joint. In the case of pouring brass around iron, this seems to work out well as it is practiced often. However, your experience with the reverse method indicates that it is not so good. This may be due to the unequal contraction of the two metals. Metals when heated expands. However, the brass is still cool enough to chill the molten iron at that point with the result that the hole will be much larger than the rod when both pieces are cold. The blowhole probably results from the rod not being perfectly clean although it may be caused by gases liberated from the rod when it is

heated. The only way to make the rod hold that we can suggest is to slot the rod in several places to provide square sections about ¼-inch wide spaced about ⅜ or ½-inch apart. When you try casting again get the brass rod as hot as you can and pour the metal while it still is hot. You also must remember that heating brass rod coarsens its structure considerably and may weaken it to a great degree.

Q & A

Heat Runs Nine Hours

QUESTION

We want to melt 40 tons of iron in 9 hours and desire information on the diameter of the cupola, and the amount of air to be supplied. What should the velocity of air through the tuyeres be and how much will the lining burn out?

ANSWER

You should be able to melt 40 tons in 9 hours in a cupola lined to 32 inches inside. Manufacturers' data on such a cupola indicate a melting rate from 3 to 5 tons per hour. While some foundrymen use 1000-pound iron charges for short heats, we suggest that you use a 700-pound charge for your continuous operation with a coke to iron ratio of 1 to 10. This will give you good, hot iron. The ratio mentioned figures out at 70 pound coke splits. Based on a volume of 132 cubic feet of air for each pound of coke burned, when the cupola is melting at the rate of 5 tons per hour with a coke ratio of 1 to 10, 2200 cubic feet of air per minute will be required. If the speed of melting is 4 tons per hour, 1760 cubic feet of air per minute will be required.

The cupola should have 6 tuyeres about 3½ x 7 inches. These will admit the air freely and with sufficient velocity to penetrate to the center of the cupola. If you desire the bosh or pinch effect in the cupola try enlarging the diameter to 36 inches above the top of the tuyeres. Use a bed of coke that will extend 30 inches above the tops of the tuyeres. Use 20 pounds of limestone per charge and keep the slag running continuously from the slag hole.

Q & A

Makes Tire Molds

QUESTION

We are thinking of adding tire molds to our regular line of gray iron jobbing castings, but we understand these castings must be poured from metal that differs from our regular mixture. We shall appreciate information on this point and on any others connected with this subject.

ANSWER

If you have a file of back copies of THE FOUNDRY you will find a complete description in the Feb. 1, 1920 issue of a foundry devoted exclusively to the production of tire molds and cores. The description covers details of patterns, flasks, cores, gates, metal distribution and metal mixtures. If you have no back file, the following brief comment may serve your purpose. A strong hard iron, but one that may be machined readily is required for these castings.

A metal mixture which fills these requirements and gives excellent results, is made from low sulphur, low phosphorus, high manganese pig iron, cast iron scrap and steel scrap in the following proportions: Pig iron, 30 per cent, shop remelts and general scrap 55 per cent, steel scrap 15 per cent. This mixture will show the following approximate analysis: Silicon 1.75 per cent, sulphur 0.07 per cent, phosphorus 0.30 per cent, manganese from 0.80 to 1.00 per cent. A cast iron ring chill is rammed up with the pattern in the drag to form the groove and to insure a dense close structure in the metal in this area. A nice balance must be maintained in the composition of the metal to prevent the chill from imparting an actual *chill* to the groove face. This face must be made as hard as possible, but still must be machinable. The usual precautions, of course, must be observed to insure clean, dry chills. If they are allowed to become damp or dirty, the molten metal will explode when it comes in contact with them. In practice they are given a slight coating of oil and then dusted with talc or plumbago. The casting is poured in the center through two or three branches and the metal must be poured rapidly to prevent waves or wrinkles in the groove.

Q & A

Not Made in Cupola

QUESTION

We desire a rustproof cast iron. We have not heard of such material, and would like to know if such material can be made in the cupola. Also will nickel and chromium close the grain, and toughen the iron without affecting the machinability?

ANSWER

There is no commercial rust-proof gray iron as far as we know. Special types containing for example 20 per cent monel metal have a much greater rust resistance than regular gray iron and in some waters may be considered rustproof. However, they are rusted readily by distilled water whose corrosive action always is more severe than ordinary tap water. Still other types of iron employing high percentages of nickel and chromium can be made almost rust resisting for even severe water conditions, but such metals are expensive in materials, hard to melt and cast, and difficult to machine. Such high chromium alloys are not feasible for cupola melting.

Small percentages of nickel and chromium will not change materially the rust resistance of cast iron. With the proper analyses, strength and hardness of gray iron often can be increased materially without affecting ease of machining. Manufacturers of nickel, chromium, alloys of nickel and chromium and natural nickel, chromium bearing pig iron for addition to gray iron, should be consulted for specific details about the use of those materials. Names will be found in the advertising section. In general nickel up to 1 or 1.5 per cent is claimed to have a beneficial effect on machinability. Chromium has a powerful effect and a small excess may cause great hardness and loss of machinability. Therefore, it should be employed with caution.

Q & A

Recovers Scrap Borings

QUESTION

I am interested in remelting and casting into pigs on an average of 20 tons of cast iron borings and 15 tons of steel borings a day. Can this be done successfully in a 7-ton reverboratory furnace, or is there any other method of recovery apart from pressing into briquets?

ANSWER

There are several methods used to recover borings. Some foundrymen pack the borings in short section of light steel pipe similar to stovepipe. The ends are closed by either thin steel plates or cast iron plates which are crimped into place. These containers with the borings constitute a definite proportion of the regular charge placed in the cupola. A large automotive firm using mixture of cupola iron and blast furnace iron and an electric furnace to bring the metal to the proper pouring temperature, adds the borings to liquid charges the electric furnace and reclaims them in that manner.

You should have no great trouble in melting the borings in a reverboratory furnace with one or two precautions. First we suggest that you have a small bath of molten metal present before you add the borings. This will quickly absorb the borings without subjecting them to any prolonged oxidation. As soon as the borings are melted, and the charge well mixed, tap out half or two-thirds of the molten metal and again add borings. In this way you can operate your furnace continuously and most efficiently. You also could add ferrosilicon and feromanganese a short time before tapping and turn out pig iron of a suitable analysis. Instead of charging your furnace through the doors, we suggest an opening in the roof with a funnel arrangement into which the boring could be dumped. This will save handling. The opening could be closed with a small firebrick bung. If you are contemplating to melt the borings to compete with pig iron, caution is advocated. Consider every item of cost that will enter. For your guidance we suggest a careful perusal of "Process Is Expensive" which appeared on page 66 in the Aug. 15 issue of THE FOUNDRY.

Problems in Nonferrous Founding

By Charles Vickers

Bushings Are Porous

We are experiencing porosity in bronze bushings about 3 feet long and 10 inches diameter containing an 8½-inch core. The mixture consists of around 75 per cent new metal and 25 per cent scrap brass of the composition, 8 tin; 6 zinc; 4 lead, balance copper. The new metal is also of the same composition. We first melt the copper add the scrap and use phosphorus as a deoxidizer. We melt in an oil-fired furnace and cover the metal with a mixture of lime and silica sand. We add the zinc about 5 minutes before taking the metal from the furnace. The castings come from the sand appearing perfect, but after machining, we find blow holes both inside and outside of the castings. The molds are dried and the castings are made upright. We have gated from the bottom and also from the top, but the results were the same in both cases.

Indications point to the metal as being at fault. It has been known though for such trouble to be caused by the cores in the case of bushings, but most of the holes will be uncovered under the skin, next to the core surface. It would be well to make certain that the cores are well vented or hollowed out in the center, and that the sand is largely sharp sand of such a texture that the bare core can be blown through. Coat the surface with plumbago, giving two coats, the first when the core is green and of a thinner consistency than the second, which is put on after the core is dried and is still hot.

The covering being used on the metal is not exactly correct, as it does not melt and it may be blown away by the blast, leaving the metal bare at times. Whether this is of great importance or not will depend on the melting time. If a No. 70 or 80 pot is pulled in about an hour, starting with a cool furnace, and in from 30 to 40 minutes with a hot furnace, a handful of calcined borax put into the bottom of the pot when charging is all the flux or covering necessary. However, if the melting of the same amount of metal requires 2 hours or more, a covering is necessary on the metal and the one now being used should be modified to 63 per cent silica sand; 25 per cent soda ash and 12 per cent slaked lime. This melts to a glass. Use only sufficient amount to give a covering on the metal about ½-inch thick. Before using this it would be well to try increasing the temperature of the furnace.

If a smoky flame is used a large percentage of spongy castings as well as slow melting will result. Use an oxidizing flame which means there must be no smoke at any time, and use the flux. If in spite of this flame the melting period is lengthened, it shows there is something wrong with the burner, or the manner in which it is introduced into the furnace. It will do no harm to oxidize the metal a little, for the phosphorus will correct that, but the reducing or smoky flame will gas the metal.

The scrap copper wire being used, should be added after the brass part has been melted. First charge the brass and put in as much copper as the pot will contain without projecting. Melt this down and charge the remainder of the copper. If the fuel is high in sulphur, it is necessary that the copper be kept below the top of the pot, out of contact with the flame as much as possible. Otherwise it may absorb sulphur dioxide, and so get gassed. These troubles are greatly lessened by rapid melting, and by bringing it out of the furnace at a temperature of 2300 degrees Fahr. Then cool to pouring temperature.

Q & A

Copper Ingots Swell

We smelt large quantities of copper and find difficulty in making our ingots as some of them swell. Can you advise whether there is any remedy in this and how we can get a smooth ingot?

There is a possibility that the casting temperature occasionally is too high, as a high temperature will cause rising in the mold. This is likely to be the case when such swelling occurs only now and again, the major part of the time the ingots come out level or at the most only slightly crowned. We suggest this be investigated, and care be taken to see that the casting temperature is as low as permissible. Also slightly overpoling the copper will give swelling of the ingot. Some heats may be overdone and when the ingots swell, pouring should be stopped and the metal should be oxidized to bring it back to the tough pitch condition. Therefore, if dropping the pouring temperature fails to bring flat ingots, it may be decided the fault is overpoling. This is a bad fault as the impurities that have been oxidized out of the copper again are thrown into solution as the cuprous oxide is reduced below the safety point.

Q & A

Babbitt Is Too Soft

We are making soap molds for a manufacturer who supplies steel dies containing the lettering. The molds are made of babbitt but do not seem to give the proper service as they are too soft. Can you supply us with a harder babbitt which will run well in the steel dies? We sometimes make the molds of brass cast in sand but the letters are not sharp enough. Will French sand help us?

Since you have neglected to mention the formula for the babbitt you now are using, it will be difficult to suggest a harder composition. We suggest motor babbitt composed of 100 pounds of tin, 10 pounds of copper and 10 pounds of antimony. That makes a hard alloy which does not flow as easily as the so-called genuine babbitts due to the higher copper content. However, it is used where the material has to withstand considerable pounding.

Perhaps you can use a zinc base alloy for making the molds. Try one containing 85 per cent zinc, 10 per cent copper and 5 per cent aluminum. That alloy is slightly different from the composition of a well known proprietary alloy containing only 4 per cent aluminum and 0.10 per cent magnesium. It is a hard alloy and should be poured cool.

We cannot say whether French sand will help you as much depends on how it is used. We would prefer the old fashioned method of printing back using *beam dust* from the foundry rafters as the facing. Remove the pattern from the mold. Dust the face with beam dust shaken from a bag. Shake on some lycopodium and carefully place the pattern back into the cavity. Rap the pattern down slightly, but firmly, and withdraw. Beam dust also may be used similar to a regular facing. Moisten it carefully with molasses water to the correct temper, then shake on the pattern through a screen. Do not rub, but shake it through the screen.

Fundamentals of

FOUNDRY PRACTICE

Choice of Ovens and Other Methods of Drying Molds and Cores Is Offered in Great Variety

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part XIX

THE majority of foundries require ovens for drying molds and cores. One type consisting of an open fire-box with natural draft, shown in Fig. 243, is used. The damper in the chimney is regulated by trial until proper results are obtained, and then propped in that position.

If the fire burns too fast, it may burn the cores without drying them through. In some instances blowers are installed to supply forced draft. This system permits burning coal or coke dust. The fire-box may be located on the outside and the hot air as well as the gases of combustion are led into the oven by flues as shown in Fig. 244.

Steel Ties Are Used

Forced draft ovens are desirable in large plants where the operating personnel can be kept busy looking after several ovens. Some ovens are built with double walls for circulating the hot air between them.

The tracks for the cars carrying the molds and cores are laid with standard rails. Steel ties, usually channel sections, are used on the inside of the ovens, while those on the outside may be of wood. It is quite an advantage to use iron ties also through the foundry, as the level rails may be used as a base for open sand molding. The oven cars are built of steel or iron. Fig. 245 shows a standard type of oven car. The wheels are cast iron and the axles roll under the car to facilitate moving them.

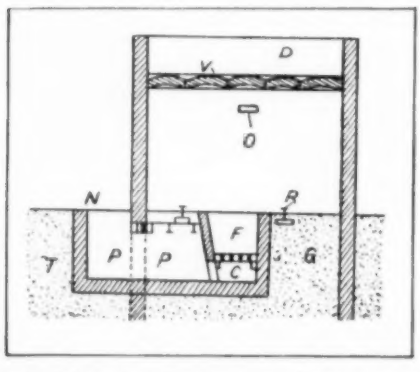


Fig. 243—Common Type of Core and Mold Oven

Select the Oven

THE present installment of the series is the beginning of the fifth section into which the work originally was divided. Subjects already covered include: Section 1, sand; Section 2, elements of molding; Section 3, typical jobs; Section 4, molding practice continued. The present division 5, covers drying cores and molds, types of ovens and equipment, portable ovens, other drying methods, gas burners and salamanders. Section 6 to follow, has been divided into several parts for convenience in presentation and deals with melting practice in all its varying ramifications to the extent of five installments.

Where heavy cores or molds have to be placed in the ovens, sills are embedded in the ground, carrying rollers spaced 3 to 4½ feet apart as shown in Fig. 246. The car is a strong metal box, which slides over the rollers. The stove must be provided with flues so that the radiated heat does not burn the molds or cores. In another type of oven, a number of iron balls rolling in grooved iron containers, take the place of the sills and rollers. The majority of foundries making cores and molds of different sizes, require shelves on which to place them. These shelves usually are made of light metal permitting the ready passage of the heated air.

Core ovens are in general use in foundries. They permit drying large quantities of cores with an insignificant consumption of fuel, coal, coke, gas, oil or electric current. Formerly, cores were made of fat sand and could remain in the stove for several hours without inconvenience. They were placed in the oven in the evening, at the same time as the molds and were taken out the following morning.

In modern practice large numbers of cores are made from sea or river sand to which various kinds of binders have been added. The combustion temperature of these binders is quite low. It has become necessary to watch closely the baking of cores. Modern core ovens permit this close watching and removal of cores at the proper time.

Swing on Axis

Ovens constructed according to Fig. 248 consist of a sheet metal cabinet, in which the doors are attached directly to the shelves. The shelves are quarter circles of perforated sheet metal, upon which the cores are placed. The axis of each door is attached to one of the side members of the oven. A door at the back of the shelf closes the opening when the shelf is opened for removing or receiving cores, thus preventing the heat from escaping.

Coke usually is employed for heating these ovens. An opening in the bottom of the oven and a chimney on top assure good natural draft. One disadvantage of this type of stove lies in the space lost inside of the cabinet owing to the form of the shelves. Rubbing of the shelves

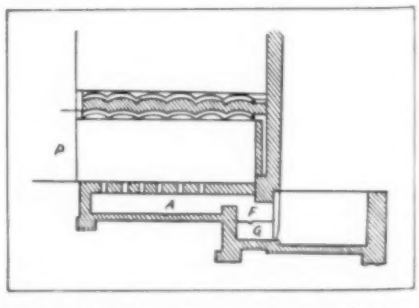


Fig. 244—Heat From the Fire Enters Through Openings in the Floor

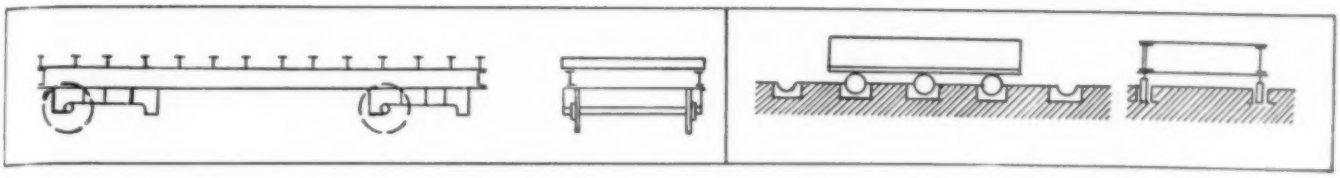


Fig. 245—(Left)—Movement of This Type of Car Is Facilitated by the Special Shape of the Bearings Over the Wheels. Fig. 246—(Right)—Instead of Moving on Wheels, This Car Moves on Rollers Set in the Floor

against their frames results in the wear of the hinge pivots due to the wear being steadily in one direction.

Ovens with shallow drawers, Fig. 249 are suitable for foundries which require large quantities of small cores. The outside of the oven has double walls. The inner space is filled with asbestos for heat insulating purposes. The rear end of the drawers rest on two rollers mounted on ball-bearings and the drawers can be slid along two round steel bars. The front end of the drawers carries a roller mounted on ball-bearings, which rolls over a horizontal bar placed on the outside and suspended from an overhanging framework. The stove is in the lower end, and as the oven is fairly high, it is sunk about 12 inches below the floor level so that the top drawers are easily accessible.

Shelves Are Open

Core ovens with rotary shelves shown in Fig. 250 consist of a sheet metal cabinet heated by a coke fire. The cabinet contains circular openwork shelves attached to a vertical rotating shaft.

One-half of each shelf always is subjected to the heat. A partition erected on a center line of each shelf serves as a door to always keep the oven closed. As soon as one lot of cores is baked, a half-turn of the shelf swings them out and swings in a fresh lot of cores which previously have been placed on the empty half. A low fuel consumption is claimed for this type of oven. Approximate dimensions are: Height 6 feet, width 4 feet, diameter of shelves 3 feet, 8 inches.

The axis of rotation is in the center and the stresses to which it is subjected do not tend to bend the

Fig. 247—Rack Used for Drying Small Cores

shelves. The oven itself is semicircular in shape. There is no lost space, and maximum efficiency is obtained from its use. The fire place is located at the bottom and an opening at the bottom allows for natural draft. These ovens may be fitted for use with any form of fuel.

For small and medium size cores made in large quantities, the rack type oven finds wide application in American foundries. A rack mounted on wheels is shown in Fig. 247, but it also is constructed to be used without wheels either on a lift truck or suspended from a monorail. The rack resting on four legs is placed near the coremaker's bench and loaded with cores. Then a lift truck picks it up and deposits it in the oven. After the cores are dried the operation is reversed.

Cores Dried in Motion

In the continuous type of oven, the rack suspended from a monorail is loaded while in motion outside the oven. It then passes through the drying area and cooling area and when it emerges, the cores are removed. Then the cycle is repeated. In another style of oven the cores are loaded on shelves attached to an endless vertical chain.

In pit molding large castings with or without a pattern, it is customary to dry the mold by a coke or anthracite coal fire in which the radiated heat dries the sand and removes the moisture. A dried mold is stronger than a green mold and wherever a casting requires particular qualities of finish, resistance to hydraulic pressure, to shocks or to tractive efforts, the foundryman's efforts are directed toward securing a sound casting. Particular castings often are poured in

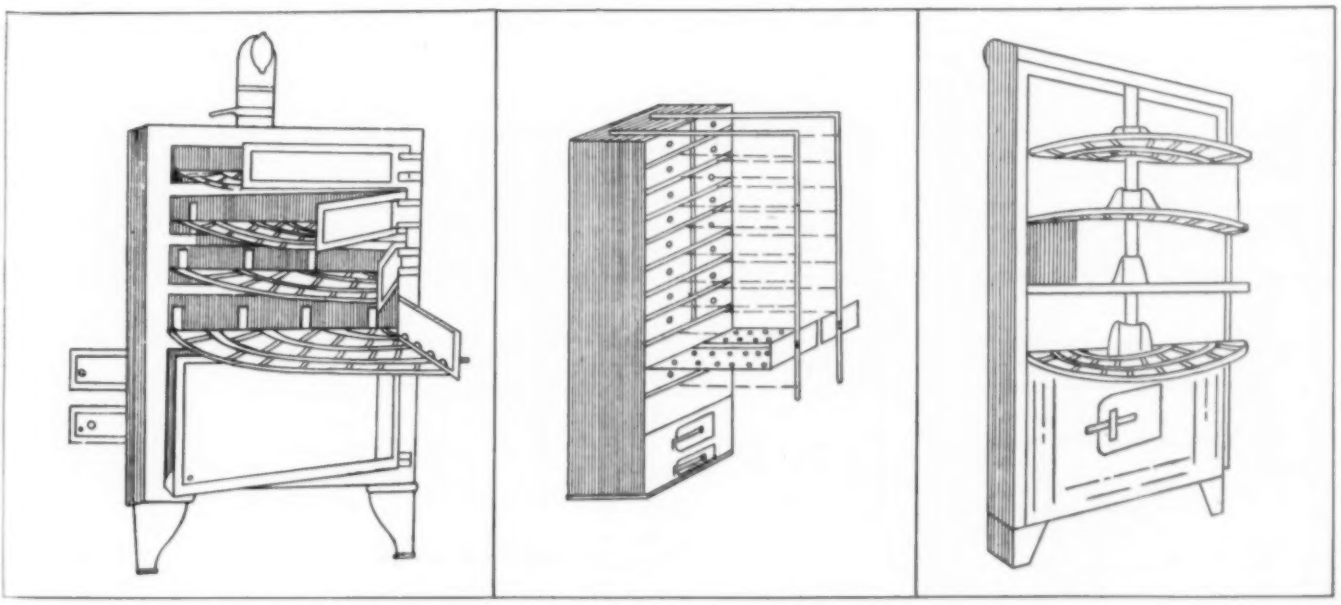


Fig. 248—(Left)—Portable Type of Small Oven. Fig. 249—(Center)—In This Type of Oven the Cores Are Placed on Sliding Drawers. Fig. 250—(Right)—Each Circular Shelf Is Provided with a Door Across the Center

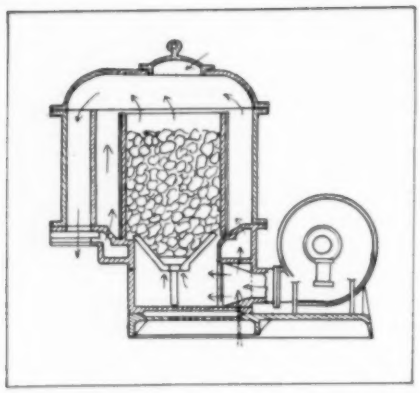


Fig. 251—Portable Outfit for Drying Molds with Hot Air

green sand molds, because this method of molding is cheaper, although in some instances one runs the risk of paying more in the end due to the amount of cleaning required. Sometimes the foundryman hesitates between molding in green sand and molding in dry sand on account of the high cost of drying.

Use Portable Dryers

Although many foundries use portable dryers, still a lot of inconveniences may result from the design of the apparatus. Refractory linings give out and require repairing and renewals which ties up the equipment. The air distribution and control depend on one, two or three valves, which are independent of each other and prevent really satisfactory operation. Many devices produce excessively heated air which burns the molds and causes the sand to stick to the casting. Some dryers are provided with winding ducts which impede the air flow and cause considerable loss of pressure.

The patented dryer shown in Fig. 251 has an inner stove consisting of a cast iron pot and a grate, enclosed in a cast iron chamber. The stove burns coke. An electric blower drives part of the air under the grate and part around the iron pot. The air which blows under the grate promotes combustion and raises the pot containing the coke fire to a red heat. Some of the air coming from the blower becomes heated by absorbing heat from the pot. It then mixes with the gases of combustion and the air passing through the stove and passes out through a duct which leads to the mold. The dryer is placed under or alongside the flask, depending on the shape of the casting. The cope is raised 1 or 2 inches and the opening all around the joint is closed by pieces of iron or a row of bricks.

The air entering the mold must escape through the openings provided, the vents, gates and risers. Some of the hot air also may be allowed to escape at the corners of the flask joint. The device shown in Fig. 251 cannot burn the molds because it has only one valve which allows the air to pass completely around and through the stove. The drying penetrates deep into the molds. The drying temperature does not exceed 300 degrees Fahr.

Many mold drying stoves are equipped with refractory linings. One of the oldest types is that shown in

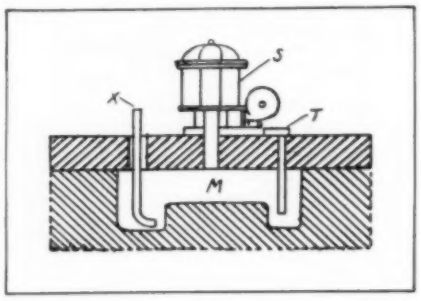


Fig. 253—Special Appliances for Drying Parts of the Mold

Fig. 252. A chamber lined with refractory bricks contains the coke fire on a grate. An electric blower with dampers distributes the air under the grate and over the top of the stove. The hot air and gases of combustion are conducted to the mold through a vertical pipe located at the base of the dryer. These stoves unless watched closely may burn the molds. The air passing through is heated highly and is difficult to regulate owing to the frequent refueling required.

Anything that opposes or retards free entry of the heated air into the molds, reduces the efficiency of the apparatus. The apparatus therefore should be placed as close to the mold as possible, under it if possible, and the air conducted directly into it through a duct at least as large as

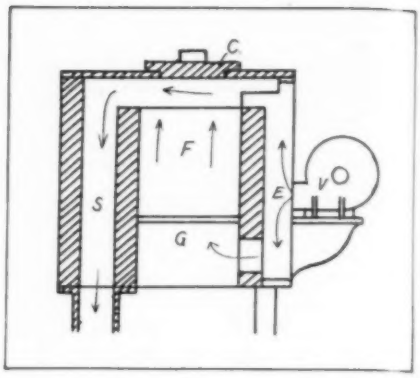


Fig. 252—The Air Is Driven up Through the Fire

the outlet of the mold dryer.

In that way loss of pressure and cooling of the heated air is prevented. The mold receives the full output of the dryer. Only one mold should be dried at a time. It is advisable to pass a large volume of air through the mold which will dry it quickly.

Efficiency Is Low

Some foundrymen have installed long hot air ducts but their efficiency is low. They are cooled from contact with the surrounding air. Others attach a sort of distributor from which ducts lead to the various parts of the mold. In this case also there is a loss of heat and capacity. Furthermore, such ducts raise the temperature considerably in the foundry and greatly discommode the workmen.

Every foundryman should acquaint himself with the following principle which constitutes the basis of drying by portable stoves: If no air comes out, none can be forced in.

Hot air circulating through the mold absorbs the moisture. Therefore an adequate outlet must be provided for the moist air.

Where air is forced into the center of the mold, an opening must be left at the corners. The upper flask always should be raised at least ½-inch to permit circulation of air and escape of moisture at the joint. On some molds, for example a flywheel with spokes, the flask should be raised at least 4 inches.

Bosses, shoulders, deep hollows, flanges etc. in the bottom of the mold, should be supplied with hot air

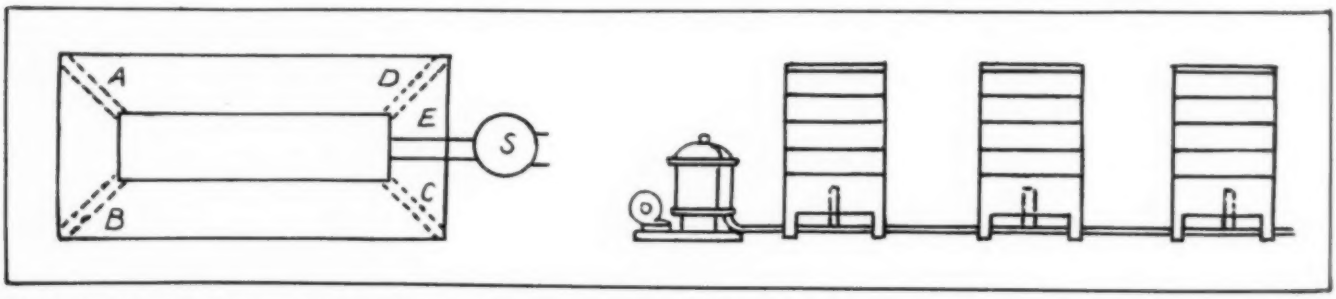


Fig. 254—(Left)—Diagram Shows Passage of Hot Air. Fig. 255—(Right)—One Dryer May Be Rigged To Serve Several Molds by Suitable Piping and Valve Connections

by a curved or a straight duct as shown in Fig. 253. In a rectangular mold shown in Fig. 254 with a core print along one of the shorter sides, air is let in through one end at *E*. The gates *A* and *B* are left open, while *C* and *D* are closed. After the drying has proceeded for a sufficient time to dry the mold, the openings *A* and *B* are closed and *C* and *D* are opened.

No advantage is gained in drying a mold at a high temperature which causes cracks, burns the blacking and deforms the mold. A temperature of 300 degrees Fahr., is sufficient and endeavor should be made to send through a large volume of air. In some plants the dryers are attached to high pressure air lines. Flexible ducts must then be employed.

Small molds may be dried by portable dryers provided they are used during the day, when help is available to look after them. This also applies to core ovens which may be supplied with hot air from a duct running underneath as shown in Fig. 255.

In certain large plants gas is available from the blast furnaces and sometimes is used for drying molds. Underground ducts conduct the gas to burners placed in the stoves or in the bottom of the pouring pits.

Where a foundry is called on to dry a large mold out of the ordinary line of work, coke or charcoal fires are built on sheet metal plates supported on iron skids or rails. The drying is effected by the radiated heat, but is slow and tiresome.

Salamanders of various types, sheet steel or cast iron, are used extensively for drying larger deep molds. The fuel cost is high and efficiency is low.

Magnifying Glass Shows Defects

IN discussing cast iron with a foundry expert the writer recently claimed that the foundry foreman or the man mixing the iron, armed with a magnifying glass, could form a pretty accurate idea of the physical characteristics. Observant men have learned to place great reliance on the evidence disclosed by the glass and use it to check against the chemical analysis.

Recently the writer was shown a piece from a broken casting and an opinion was asked regarding the strength of the iron. Under my glass the iron showed a torn structure and I said a transverse test would show a strength of between 3800 and 4000 pounds per square inch. The break was torn instead of being clean, there were no planes of graphite, the grain was fine and the graphite evenly distributed. An actual transverse test had shown a strength of 4100 pounds.

Not Always Blow Holes

Every foundry foreman has been called into the machine shop to see a casting filled—according to the machinist—with dirt and blowholes. The iron may be too rich in graphitic carbon and therefore spongy. The holes may be due to occluded gases, to shrinkage or to segregation, but the machinist refers to them all as dirt and blowholes.

Sometimes the foundryman is told his iron is too hard. Perhaps he increases his silicon next day but forgets the manganese. He may increase the silicon and drop the sulphur and forgets how many points of silicon are required to offset one point of sulphur. He has to jockey all the elements. Many features must be considered in an iron mixture and their effect on contraction and expansion. An examination of a defective casting through a magnifying glass frequently discloses the cause of the trouble.

In former years it was nothing uncommon to hear or read of fly wheels bursting on large engines with consequent wreck of buildings and loss of life. In many instances the iron for these wheels was mixed and melted by men who had no knowledge of the subject.

In one instance his superiors found fault with a foreman for the character of the iron he insisted in putting in the fly wheels. He insisted on a hard strong iron on account of the tremendous strain involved when the wheel was running at high speed. They called in a chemist to back up their opinion. He saw the wheels running and he claimed the foreman was right.

"If you decide to put softer and weaker iron in those wheels," he said, "I don't want to stand so close to one of them as I stood today."

The foundryman often is blamed for conditions over which he has no control. Many years ago I read of the visit of a noted English iron master to this country. At that time there was considerable discussion on why some brands of pig iron showed irregular grain structure on a broken surface. Chemical analysis of pig iron was in its infancy, at least so far as foundry practice was concerned. The gentleman was asked if he could explain the phenomenon. "Yes," he said. "Oh, yes. Well its because we have the same thing in the old country!"

Frequently the machine shop reports that castings are too hard when as a plain matter of fact, hardness is the quality required by the customer. A certain employer asked his foundry foreman why a number of cylinder castings were rejected by the machine shop and thrown on the scrap heap. The foreman claimed the cylinders were perfect, but the machine shop would not accept them.

The owner ordered the machine shop foreman to take one of the castings from the scrap heap and machine it. After watching the operation for a while he asked the machinist what was wrong with the casting. The machinist claimed that it was too hard to machine properly.

"Listen," said the owner. "That is the kind of cylinder I want. You want them soft because you work on a piece rate base. I want cylinders that will stand up in service. Heretofore we have made cylinders to suit you. Hereafter you will machine cylinders to suit me."

Cost Men Hold Meeting

S. L. Whitestone, comptroller, General Electric Co., Schenectady, N. Y., addressed the Sept. 10 meeting of the New York chapter of the National Association of Cost Accountants on "Stabilization of Employment." General Electric Co. has studied the problem and has developed a plan to minimize the cause and effect of unemployment. The plan has been commented upon by several industrial leaders. The next meeting of the chapter will be held on Oct. 14 when E. S. LaRose, assistant comptroller, Baush & Lomb Optical Co., Rochester, N. Y., will speak on budgetary control.

Book Review

Methods of Testing for Foundry Moulding Sands, paper, 35 pages, 6 x 9¾ inches published by the British Cast Iron Research association, Birmingham, England, and supplied by THE FOUNDRY, Cleveland, for $2.50 and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 10s 6d.

As a part of its research work, the British Cast Iron Research association examined available British natural molding sands, and in the examination applied scientific tests that would yield information of value to users of the sands. The test methods adopted in the examinations are described in detail in this bulletin. Methods included are: Sampling; milling or treatment before examination; moisture content; ramming dry sand tests; mechanical analysis, strength; permeability; expansion and contraction; refractoriness, and chemical analysis. A bibliography of articles also is included.

Steel Group Sees Pickup

Members Attending Meeting at Pittsburgh Report Prospects Are Somewhat Brighter—Secretary Davis Addresses Meeting

THE chump of the business world is the manufacturer who sells his product below the cost of production and then cuts wages of his employes to make up the deficit, declared Secretary of Labor James J. Davis, in an address before the Steel Founders' Society of America, Inc., at Pittsburgh on Sept. 11. Competition is proper when confined to competition between rival efficiencies, but it is an entirely different story when it leads to wage reductions and salary cuts.

Business Is Improving

Indications that business is picking up are descernible through the country, according to the secretary, who believes that industry should congratulate itself in being able to see the pendulum swing in the right direction after so short a time. While all have been carried to such a depth of pessimism that anyone who ventured to say that good times would return was labeled a "Pollyanna," unmistakable signs of health and vigor are beginning to show themselves. Recently, agreements have been reached that guarantee peaceful relations in an industry employing 150,000 workers. A big Eastern concern has just added 1000 employes to the payroll and the latter part of the month 21,000 workers will be called back to work in another industrial city.

According to Mr. Davis, the time is not far distance when the periods of unemployment will be a thing of the past. The genius of America has practically put out of existence such things as famine and pestilence, evils that once were thought beyond the power of man to control. Employment soon will be placed in the same category for the genius of industrial leaders is certainly equal to the task of solving this problem. Once the men of industry have centered their energy upon it, unemployment, like the other plagues, will disappear.

The secretary paid tribute to the work of the Steel Founders' society and declared that if that group can assist in stopping unfair competition, the sort which is ruining the business of the country and forcing companies to sell below the cost of production, it will have done something eminently worth while.

Reports of members of the society attending the convention indicate a trend upward in business, although operations at present are spotty. In a majority of instances, September operations started off a trifle in advance of August and many see hopeful signs in the near future. It was brought out that the drafting rooms of machine tool manufacturers are busy working on the design of new tools and that considerable business from that quarter would be ready for the foundries in the near future.

In mid-August, out of 60 companies reporting, 20 were operating below 50 per cent, 18 between 50 and 59 per cent, seven between 60 and 69 per cent, six between 70 and 79 per cent, three between 80 and 89 per cent, three between 90 and 99 per cent and three over 100 per cent of capacity. Out of 58 reporting on the business outlook thirty days ago, 3 reported that prospects are good, 43 fair and 12 poor. During the past month, this outlook has acquired a more cheerful aspect.

Regular business of the society was transacted at the morning session, with John E. Galvin, Ohio Steel Foundry Co., Lima, O., and vice president of the Central Atlantic division of the society, presiding. Granville P. Rogers, managing director of the society, reported that copies of the standard cost accounting system, which has been prepared by the cost committee, now are ready for distribution to members of the society and that copies may be purchased by nonmembers. The material has been prepared in loose-leaf form so that necessary additions or corrections may be made from time to time to keep the system up-to-date. He stated that six new members had been added to the society at the meeting of the board of directors immediately preceding the session, making a total membership of 75. A new membership drive committee has been appointed with S. Wells Utley, Detroit Steel Castings Co., Detroit, chairman.

To Meet in New York

The next regular meeting of the society will be held in New York on the day preceding the meeting of the American Iron & Steel institute. The meeting, which normally would be held in November, has been postponed to Dec. 11 and will be held in Chicago. Mr. Rogers stated that 15,000 copies of the standard trade customs developed by the society had been distributed to purchasing agents and that a gratifying response had resulted. He spoke of the invitation to appoint a member on the joint committee on foundry education in engineering schools, which is sponsored by the American Foundrymen's association, and stated that a representative of the society would be appointed in the near future. Reports were made by R. J. Doty, Reading Steel Casting Co., Reading, Pa., chairman of the technical research committee; T. H. Harvey, Ohio Steel Foundry Co., Lima, O., chairman of the merchandising committee and by W. H. Worilow, Lebanon Steel Foundry, Lebanon, Pa., and Ralph F. Tillman, Industrial Steel Casting Co., Toledo, representing two divisions of a committee developing new uses of steel castings. The merchandising committee was authorized to plan a convention of steel castings salesmen at a future meeting of the society. Chairman Galvin suggested that it might be exceedingly beneficial for the society to prepare and publish a manual for salesmen.

Research Progress Outlined

Following the report on business conditions at the opening of the afternoon session, Dr. L. W. Bass, executive assistant, Mellon Institute of Industrial Research, Pittsburgh, spoke on "Industrial Research and Progress." Dr. Bass outlined the progress that has been made in industry through the application of the results obtained through industrial research. He stated that the business of research at present is good, for in times of industrial depression, companies look to the research laboratory to better their positions. Research is undertaken to develop new uses, new materials, new processes and to eliminate waste. Managerial research follows lines of cost accounting, etc., while economic research will deal with the conditions in the industry. It was pointed out that the results of research are manifested slowly, it usually requiring from 2 to 5 years to transfer the results of the laboratory to the industrial application. Research in the broad meaning may be considered as insurance against obsolescences of both products and processes, according to Dr. Bass.

Meetings of both the large and small castings divisions were held following the general session in the afternoon. G. R. Casey, Treadwell Engineering Co., Easton, Pa., presid-

(*Concluded on Page* 112)

PRESSURE PIPE IS CAST *Horizontally-II*

Details Are Presented in Coremaking, Shakingout and Cleaning of Long Pressure Pipe Cast in Green Sand Molds

By Pat Dwyer

METHODS and equipment employed in molding, pouring and shaking out 16-foot lengths of cast iron pressure pipe in the green sand foundry of the McWane Cast Iron Pipe Co., Birmingham, Ala., were described in a preceding article in this series, published in Sept. 15 issue of THE FOUNDRY and beginning on page 48.

The green sand cores are made according to the method first developed in the soil pipe industry. The method is so simple and perfect that it still is practiced universally without any change from the original method first introduced about 40 years ago.

Green sand cores swept on revolving barrels were known long before that time. The present writer as a boy, helped to make them and recalls old grizzled veterans of those days refering to similar experience in their apprentice days.

In these various early experiences the sand was packed on the barrels with the hands and was brought to the proper shape and diameter by a long straight edge or strike mounted on two supports and designed to engage the sand on the revolving barrel along a center line. The practice practically was similar to that employed down to the present in the making of loam cores.

In the present practice of making green sand cores, the practice which dates back approximately 40 years, and the practice pursued at that plant of the McWane Cast Iron Pipe Co., the prepared sand falls on the barrel in a thin stream with sufficient force to pack it to the required density. The greater part of the coremaking equipment was supplied by C. O. Bartlett & Snow Co., Cleveland.

The long steel barrel perforated freely with vent holes is dipped in a water tank before it is placed on two end bearings. A simple, quick acting motor driven clutch is attached to one end and the barrel is set in motion. The speed varies to some extent according to the diameter of the barrel. For a 6-inch core the speed is approximately 100 revolutions per minute and the average time per core on a run of 100 is about ½ minute. Actual time of applying the sand to the barrel is only 10 seconds. A long strike, reinforced with a steel strip along the cutting edge and adjusted accurately to the proper diameter, removes the surplus sand from the barrel and leaves a smooth, straight core, accurate to within a plus or minus tolerance of a few thousandths of an inch.

Sand for a twin unit where the cores are made, is prepared in equipment supplied by the National Engineering Co., Chicago. The sand, carefully controlled in permeability and water content is prepared outside the foundry and then brought in and

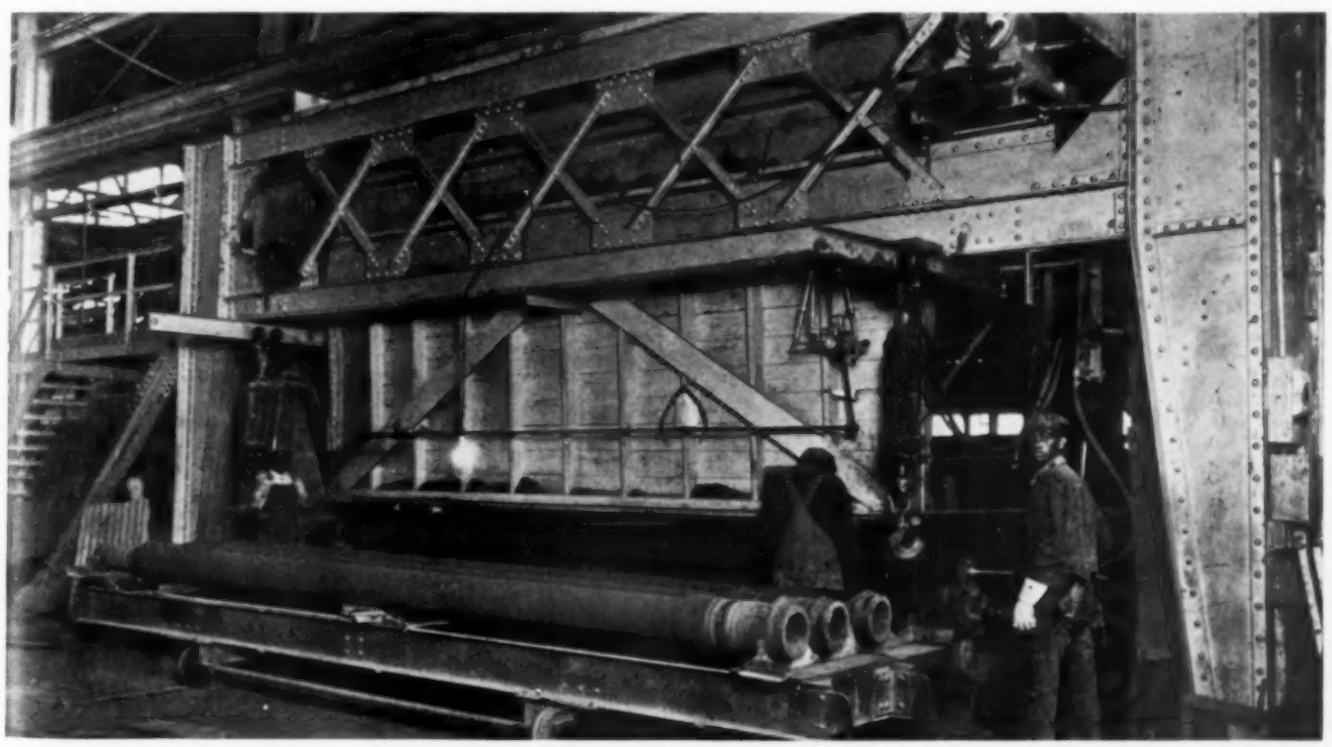


Fig. 1—*Green Sand Falling in a Narrow Stream from a Hopper on to a Rapidly Revolving Barrel Forms a Straight Smooth Core. The Cores Are Loaded on a Special Car*

Fig. 2—One of the Battery of Long Tumbling Barrels in Which the Pipe Castings Are Cleaned

lifted by a bucket elevator to a storage hopper over the coremaking machine. A long, horizontal rod within reach of the operator, starts and stops a motor which releases or stops the flow of sand in a vertical wooden chute. A long, narrow orifice in the bottom of the chute directs the sand on a top center line on the core barrel.

One of the coremaking stations with the various items of auxiliary equipment is shown in Fig. 1. A length of I-beam at each end supports a short air hoist traveling on a trolley and equipped at the lower end with a special device for inserting into the open end of the core barrel. This air hoist is employed to lift the empty barrels from the skidway at the back of the machine and place them one at a time in the bearings where they are revolved and where they receive a coating of sand approximately ¾-inch thick. The same hoist then lifts the finished core and places it on a long car with suitable supports on the ends for four cores. The loaded car is lifted away by one of the overhead electric cranes and placed close to the mold assembly section of the floor. Here the cores are lifted individually by the crane and placed in the molds. An empty core car is placed in front of the core making station and the exchange of cars is repeated steadily throughout the day.

After the molds are shaken out as described previously, the pipe castings with the cores still in place, are lifted on to a transfer car which takes them into an adjoining bay. Here they are rolled on to a skidway and then lifted one at a time by a crane and placed upon the special tilting device shown in Fig. 6. This device is equipped with vibrators which go into action as the platform starts to move from a horizontal to a tilted postion. By the time the pipe has attained an elevation of approximately 45 degrees almost all the sand has escaped and the core barrel follows. An air cushioned carrier allows it to sink slowly until it has cleared the pipe. Then the table is tilted back to a horizontal position. The pipe is rolled forward on a skidway leading to the cleaning room while the core barrel is rolled in the opposite direction on a second skidway leading to the core making station.

The pipe skidway terminates at a specially designed scrubbing machine shown in Fig. 3 where the rapidly revolving pipe comes into contact with a great number of hard iron scrapers mounted individually on a long horizontal bar. Small pipe in 6-foot lengths and larger sizes in 12-foot lengths are cleaned in a battery of tumbling barrels of the general type shown in Fig. 2 and built by the Whiting Corp., Harvey, Ill.

A small chain hoist suspended from an I-beam is empoyed to lift the casting into and out of the barrel and the cleaning action is effected by hard iron stars or jacks. Each tumbling barrel is direct motor driven and is equipped with dust arrester attachment.

Each pipe is submitted to a water test at 500 pounds per square inch pressure. The method and equipment for applying this test are shown in Fig. 7, and are similar to those employed in other pipe shops described in preceding numbers in this series.

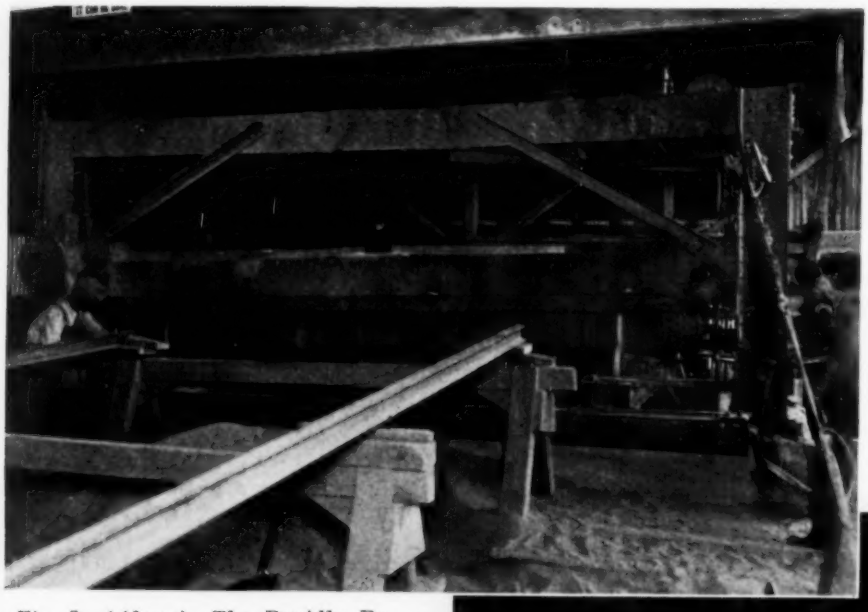
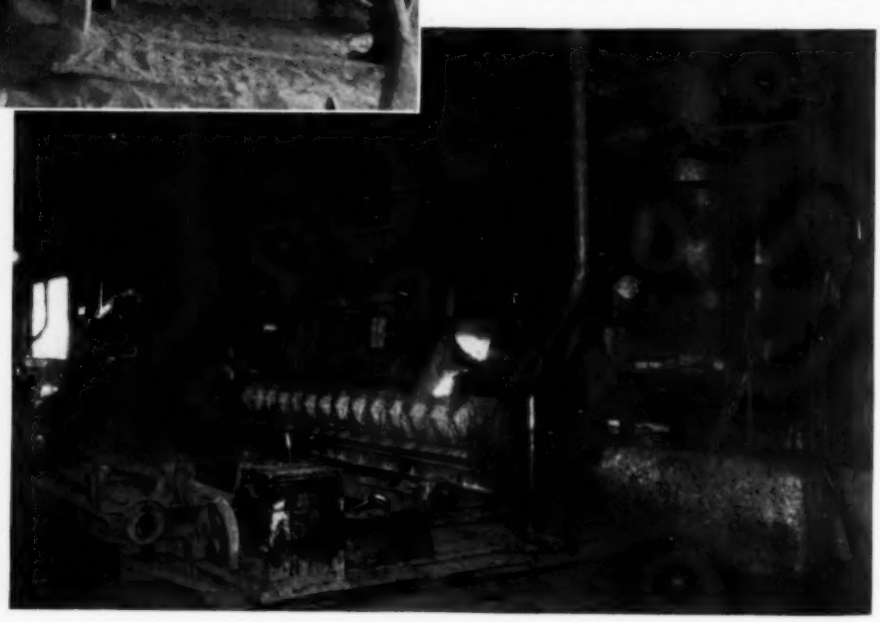


Fig. 3—(Above) The Rapidly Revolving Pipe Is Subjected to the Cleaning Action of a Long Row of Small Iron Blocks Attached to a Movable Head

Fig. 4—(Below) A Transfer Car Is Employed To Manipulate the Special Ladles in Front of the Cupolas



Method and equipment for applying the usual pitch coating inside and outside the pipe also follow orthodox practice with the single exception that the pipes are water tested before the coating is applied, whereas the usual custom is to coat them first and apply the water test afterward.

To meet certain conditions, a cement coating is specified for the interior of water pipes. This cement lining to a thickness of approximately ⅛-inch is applied centrifugally. The pipe is placed horizontally with the ends resting on opposed rollers that may be started and stopped at will. A long narrow trough designed to hold a definite amount of cement, mixed to the required consistency, is filled with cement and introduced through one end of the pipe. The pipe then is started whirling and the contents of the trough are dumped against the face. Centrifugal action distributed the liquid cement uniformly over the inside surface of the pipe.

Iron for the two sections of the foundry, one section for the short lengths and fittings, and one section for the 16-foot lengths, is melted in two cupolas made by the Whiting Corp., Harvey Ill., and lined to 72 inches. Charges for the cupolas are made up in 4200-pound lots.

On acount of the low manganese content of southern iron, it is customary to add about 10 pounds of spiegeleisen to each charge in the cupola.

Pipe castings are poured from iron of the following approximate analysis: Silicon 2.25 per cent, sulphur 0.07 per cent, phosphorus 0.75 per cent, manganese 0.40 per cent.

The stockyard is spanned by a 5-ton crane made by the Harnischfeger Corp., Milwaukee. A magnet suspended from this crane is employed to lift

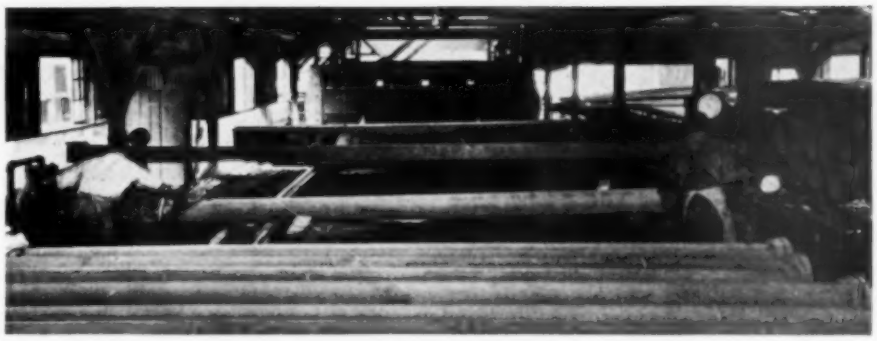


Fig. 7—Cleaned Pipe Castings on Their Way to the Pitch Tanks Are Subjected to a Water Pressure Test

the pig iron and scrap from the yard to an extension to the charging floor where the materials are dropped according to classification into various bins. A roof covers the charging floor in the immediate vicinity of the cupolas, but the extension floor is uncovered and the roof over the covered part is supported on columns instead of side walls. Climatic conditions in the district favor this type of building construction around the cupolas.

Component parts for the charges are loaded by hand on buggies, weighed and then the buggies are pushed to the vicinity of the two charging doors with which each cupola is provided. Coke, iron, and limestone are charged by hand into the cupola. One cupola melts iron continuously all day for the long pipe department. The second cupola runs two heats per day to pour off the short pipes made on two shifts.

In the first shift the molders work from 4:00 to 11:00 a.m. In the second all the molds are made between 4:00 and 11:00 p.m. Pouring commences when the floors are filled with molds and continues until every mold

Fig. 6—(Above) The Arbor Slides Out of the Pipe by Gravity After the Sand Has Been Loosened on the Vibrating, Tilting Table

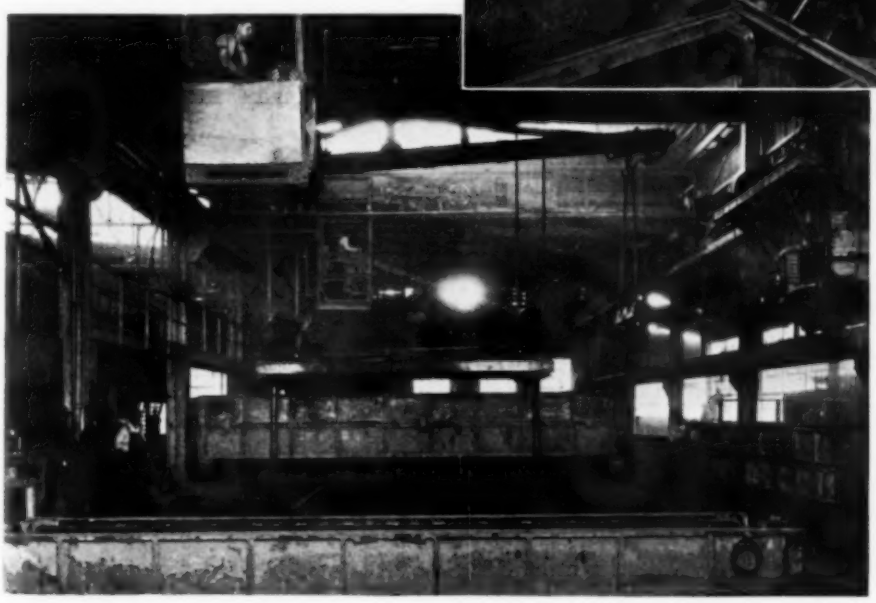


Fig. 5—(Below) A Special Device Suspended From the Crane Is Employed To Carry the Entire Mold to the Shakeout Station

has been filled with iron. A shakeout crew takes charge after each pouring period, removes the castings, stacks the flasks and arbors and reconditions the sand on each floor. The sand is prepared for use and is arranged in long windrows by two machines made by the American Foundry Equipment Co., Mishawaka, Ind.

All the iron is poured from multi-lipped ladles. The only essential difference between the ladles used in the two sections of the foundry is that in one the ladle is comparatively short and is equipped with only four lips

while in the other section of the foundry, the ladle is 16 feet in length and distributes the molten iron simultaneously through 14 lips. The lips are attached to the ladle in such a manner that iron enters at the bottom and emerges at the top, thus constituting a self skimming unit.

An electrically operated transfer car is employed to spot the ladles in front of either cupola and to supplement the cranes in the passages of the ladles between the cupolas and the various stations where the iron is distributed.

Molten iron throughout the duration of a heat, runs constantly from the spout into a special 4-ton ladle with one flat side which nestles close to the side of the cupola spout and serves as a receiver. As each multilip ladle is spotted in front of the spout, the reservoir ladle is tilted from the back by a cable attached to an air hoist and the required quantity of metal is spilled into the pouring ladle. Slag from the cupola comes out through the tap hole with the metal and is separated in the spout where it runs over one side while the iron flows under a trap in the spout and thence into the waiting ladle.

Make Small Pipe

Small size pressure pipe in 6-foot lengths are made in five of the foundry bays with two floors extending longitudinally in each bay. The patterns are mounted in pairs. The molding machine in effect is a bench mounted on wheels which follows the diminishing sand pile from one end of the floor to the other end. The patterns are dropped part way through this iron bench after the flask has been rammed. A quick acting hand lever on the side lowers and raises the patterns as required. Automatic clamps on the side also grip the flask and hold it in position during the ramming period.

The same accuracy in equipment and method noted in the long pipe section, also is in evidence here. The job of producing these pipes has been divided into three logical parts, molding, coremaking and shaking out. Men rapidly develop speed and skill in their particular specialties. The molds are rammed by hand in close fitting flasks with slanting sides and with bars in both cope and drag.

After the short pipes are cleaned they are tapped and threaded on the ends and assembled in groups of three, thus constituting 18-foot lengths for the convenience of the contractor in laying them when they arrive at their destination. Each three-section length is tested by placing it in a tank and subjecting it to air pressure while under water.

A well equipped machine shop is maintained on the premises for effecting repairs, for machining special pipes and for preparing flasks and patterns. Compressed air for the various items of pneumatic equipment is supplied by a direct motor driven twin compressor made by the Hardie-Tyne Mfg. Co., Birmingham and by two smaller machines, one made by the Chicago Pneumatic Tool Co., and the other by the Ingersol-Rand Co., New York.

This is the eighth of a series of articles dealing with the cast iron pipe industry in the South. Succeeding articles are scheduled for publication in early issues of THE FOUNDRY.

The Editors

Chicago Building Topped by Aluminum Statue

Aluminum has come to the front in the past few years as an architectural material to modernize the decorative design of many new buildings. Chief among the reasons for its adaption is its resistance to atmospheric corrosion. Others are its lightness and the various shades that it may be made to assume by different treatments. Typical aluminum castings used for decorative purposes include spandrels, mullions, window sills, roof cornices and crestings, copings, facias, grilles, radiators, covers and statues. In 1928, the city of St. Louis constructed a new civil court house, which rose approximately 400 feet above the street level. The cap sheaf of the building was composed of two aluminum sphinx to signify dignity and justice. Total length of the casting was 19 feet 10 inches; greatest width, 12 feet and extreme height, 11 feet 9 inches. A description of the methods used to produce the casting was carried in the Oct. 15, 1928 issue of THE FOUNDRY.

Surmounting the New Chicago Board of Trade Building Will Be an Aluminum Statue 31 Feet High

Aluminum alloy was used recently to produce a figure to surmount the new Board of Trade building in Chicago. The figure, shown in the accompanying illustration, represents one of the greatest activities of the board, namely wheat trade. The head of the figure is crowned with a laurel wreath symbolic of honor and the body is draped in a robe falling in folds to the feet. One hand of the figure clasps a sheaf of wheat and the other hand holds a bag. The figure is 31 feet high and weighs 6500 pounds. It was cast by the Gorham Co., Bronze division, Providence, R. I., from a special aluminum alloy for architectural purposes made by the Apex Smelting Co., Chicago.

Foundry Company Buys Radiator Plant

The Buffalo Pipe & Foundry Co., recently organized and incorporated by Frank B. Baird and associates, has taken over the idle Arco plant of the American Radiator Co., Austin street, Buffalo, and remodeling operations are under way. It is planned to begin production of cast iron pipe for the building trade at an early date.

Mr. Baird, president of the new concern, has been identified with the iron producing business for nearly forty years. He organized the Buffalo Furnace Co. in 1892, the Union Iron Works in 1898, and the Buffalo Charcoal Co. in 1899. After consolidation, the Buffalo Union Furnace Co. was formed. The latter concern is now controlled by the Hanna Furnace Co., of which Mr. Baird is a director.

Exhibit Is Interesting

That castings and the process of manufacture hold public interest is evidenced by the fact that the castings exhibit at the Newark museum has been seen by 14,000 people since opening in June. A description of the exhibit was carried in the July 15 issue of THE FOUNDRY and an article in the Sept. 10 issue of the *Newark Evening News* comments on its popularity. The article describes the exhibit and says that workers from several plants in Newark attended the exhibit in groups on special evenings and that other groups will attend in the future. The exhibit will be open until Nov. 1 when it will be sent throughout the country as a loan exhibit.

Wants Cost Information

Merchandising committee of the Gray Iron institute, Cleveland, is interested in securing information on methods used for figuring costs of alloy castings. The committee has found that there is a lack of information among foundries concerning cost of the use of alloys. The committee also has found that there is a tendency on the part of some foundries to consider the additional cost for the theoretical amount of alloy used in the casting where the actual cost sometimes has been as high as 300 per cent of the alloy cost because the alloy is present in gates, sprues, and defective castings.

Long Heating Periods at *High Temperatures* Affect Gray Cast Iron

By R. S. MacPherran and H. Krueger

OWING to prospective higher temperatures of operation, it has become necessary to know the effect of a long-time hold at high temperatures on various types of cast iron. It has also become desirable to know what types of cast iron best resist the softening or annealing effect of high temperature.

J. F. Harper and R. S. MacPherran, *Transactions*, American Foundrymen's association, Vol. 30, did some work in 1922 on annealing gray cast iron. The authors found that holding cast iron at 1050 degrees Fahr. for 3 hours had no material effect upon its hardness or strength. While this treatment has been satisfactory for the relief of casting or machine strains, the time is inadequate to determine the effect of a long-time service.

Carpenter and Rugan, *Journal Iron and Steel Institute*, 1909, found that repeated heating and cooling has a greater effect than one continuous heat. However, they conducted most of their tests above 1500 degrees Fahr., which range is not touched by this paper. O. W. Potter, *Heat Treatment of Gray Cast Iron*, A.F.A.—Belgian exchange paper, 1927, finds that annealing at 500 degrees Fahr. slightly increases strength of most irons.

J. W. Donaldson in his three papers entitled "Low-Temperature Heat Treatment of Special Cast Iron," *Foundry Trade Journal*, June 18, 1925; "Heat Treatment and Growth of Cast Iron," *Foundry Trade Journal*, Feb. 17, 1927; and "Heat Treatment and Volume Changes of Gray Cast Iron Between 15 Degrees and 600 Degrees Cent.," *Foundry Trade Journal*, Oct. 25, 1928, covered the field in detail and with great thoroughness. Donaldson finds that high silicon, high carbon and nickel tend to accelerate the decomposition of pearlite when heated at high temperatures; that low silicon, chromium, low carbon, and also phosphorus and manganese to a lesser extent, tend to stabilize the carbide and delay this action. He finds also a decided softening effect when heating at 840 degrees Fahr. for 200 hours, with a cooling after each 8 hours of heating. His method of procedure was to heat 8 hours and cool overnight, repeat the heating and cooling the next day and continue until his desired total of 200 hours had been reached. The author's results previously referred to agree with the findings of Potter, and the results of this article tend to agree with those of Donaldson.

Detail of the procedure on the present tests was varied by longer continuous holds at various temperatures. Tests were run on irons actually used in the company's foundry, particularly on high-test iron. On

Table I

Chemical Analyses and Physical Properties of Gray Cast Iron "as Cast"

(*Series A*)

Type of Iron	Series No.	Size bar "As cast"	Tot. Carbon	Comb. Carbon	Graph. Carbon	Si	Sul	P	Mn	Ni	Cr	Tensile strength	Brinell Hardness
High-test iron—low-Carbon, high-Silicon, Nickel	5-6	2 in. Rd.	2.58	0.76	1.82	2.33	0.096	0.08	0.86	1.43	0.03	63,100	259
	28	2¼ in. Rd.	2.58	0.73	1.85	2.23	0.096	0.08	0.86	1.43	0.03	55,700	274
	9	3¼ in. Rd.	2.58	0.69	1.89	2.23	0.096	0.08	0.86	1.43	0.03	54,500	246
	11	1 in. x 2 in. x 26 in.	2.77	0.76	2.01	1.84	0.094	0.08	0.69	2.46	0.02	69,100	272
	8-10	1¼ in. Rd.	2.91	0.84	2.07	1.44	0.093	0.08	0.67	2.12	.....	56,200	269
High-carbon, low-Silicon	1	1 in. x 2 in. x 26 in.	3.66	0.76	2.90	1.24	0.075	0.43	0.55	0.02	0.02	32,350	196
	14-26	2 in. Rd.	3.66	0.71	2.95	1.29	0.121	0.21	0.78	.....	.....	29,100	175
	23	1¼ in. Rd.	3.46	0.65	2.81	1.44	0.101	0.29	0.68	.....	.....	36,050	207
High-carbon, low-silicon, Nickel	2	1 in. x 2 in. x 26 in.	3.61	0.73	2.88	1.12	0.082	0.19	0.65	0.90	0.02	35,500	199
High-carbon, low and medium Silicon, Nickel, Chromium	3	1 in. x 2 in. x 26 in.	3.66	0.75	2.91	1.27	0.069	0.42	0.59	0.93	0.32	37,300	220
	4	1 in. x 2 in. x 26 in.	3.38	0.72	2.66	1.70	0.071	0.44	0.58	1.07	0.53	42,900	244

repeated heating and cooling, the effect of heat is reinforced by possible gas penetration and oxidation. With more nearly continuous heating, those actions are minimized, and the reaction produced is more nearly that of the heat alone. It is quite possible also, in a test of this character, that the composition of the surrounding gases may have a decided influence upon the amount of decomposition produced. Experiments by various investigators show a greatly decreased effect of heating when it is done either in vacuum or in hydrogen.

Describes Equipment Used

The furnace used in series *A* investigation was a hump type drawing furnace. The temperatures were determined by a base-metal couple extending into the furnace about 7 inches from the bottom. Temperatures were charted on an automatic recorder and were kept constant within a range of 5 degrees Fahr., plus or minus. The base-metal couple was checked from time to time against a platinum couple using a portable potentiometer. New material was used for each temperature run. The irons represented were made in the cupola and nickel and chromium additions were preheated and added to the ladle.

In series *A*, specimens were heated at test temperature for 7 days, cooled, removed from furnace for brinell test; replaced in furnace, heated for 7 days and again cooled and removed for brinell test; replaced in furnace and heated for remaining 7 days, or a total of 500 hours, and again cooled. Determinations were then made for brinell hardness, combined carbon and tensile strength. Varitions of those properties are shown in Tables II and IV. In series *B*, specimens were heated continuously for 500 hours at test temperature, the furnace then being cooled and samples tested for brinell hardness, combined carbon and tensile strength. Results are shown in Tables II and IV.

Varies Conditions

ALTHOUGH some work has been done toward ascertaining the effect of long heating periods on the physical characteristics of gray cast iron, most investigations have been carried out at temperatures in excess of 1100 or below 850 degrees Fahr. The authors have determined the effect of heat on various types of gray cast iron from 850 to 1100 degrees Fahr., giving figures showing the changes in combined carbon, brinell hardness, tensile and transverse strength. Tests were carried out under two different sets of conditions. The first series was heated to various temperatures for 500 hours intermittently and the second series was heated continuously. Various type irons including alloy mixtures and different section test bars were used. The article is abstracted from a paper presented at the Cleveland convention of the American Foundrymen's association. The authors are chief chemist and assistant chemist, Allis-Chalmers Mfg. Co., West Allis, Wis.

Find No Effect

From preliminary tests made on several series, the authors found no effect when heating up to and including 800 degrees Fahr. for a period of 500 hours. Accordingly, the reported tests begin at that temperature. In the *A* series, bars were cast of various diameters to give tests on the same material with different degrees of hardness due to the various sections used. In the *B* series, bars were made 1 x 2 x 26 inches and were broken transversely between 24-inch supports. All tensile bars were taken near the middle of the bar as cast and adjacent to the transverse test break. They were machined to a diameter of 0.505 inch, ends were threaded, and bars were pulled at a

Table II

Combined Carbon and Brinell Hardness After Intermittent Heat Treatment

(Series A)

Series No.	Combined Carbon — Heating to Temperatures, degrees Fahr							Brinell Hardness — Heating to Temperatures, degrees Fahr.						
	800	850	900	950	1000	1050	1100	800	850	900	950	1000	1050	1100
5-6	0.75	0.75	0.64	0.50	0.21	0.00	0.00	259	258	257	236	197	169	152
28	.....	0.66	0.68	.....	.....	.....	0.00	.....	275	273	.....	.....	.....	152
9	.....	.....	0.51	0.54	0.27	0.00	.....	.....	.....	241	230	204	160	.....
11	.....	0.75	0.68	0.39	0.06	0.00	0.00	.....	271	266	233	181	161	152
8-10	.....	.....	0.52	0.37	0.06	0.00	.....	.....	.....	250	224	159	146	.....
1	0.74	0.71	0.64	0.45	0.12	0.00	0.00	196	197	194	172	133	116	111
14-26	.....	0.73	0.64	0.56	0.24	0.00	0.00	.....	175	175	168	132	107	96
23	.....	0.69	0.55	.....	.....	.....	0.00	.....	204	204	.....	.....	.....	114
2	0.72	0.70	0.61	0.26	0.07	0.00	0.00	200	196	191	159	125	117	110
3	0.76	0.75	0.70	0.63	0.45	0.28	0.16	220	221	218	209	181	165	152
4	0.71	0.71	0.68	0.63	0.53	0.24	0.22	241	245	241	228	217	195	183

Combined Carbon and Brinell Hardness After Continuous Heat Treatment

(Series B)

Series No.	Combined Carbon — Heating to Temperatures, degrees Fahr					Brinell Hardness — Heating to Temperatures, degrees Fahr.				
	870	920	970	1020	1120	870	920	970	1020	1120
31	0.67	0.46	0.10	0.00	0.00	235	217	171	146	145
32	0.75	0.68	0.57	**0.47**	**0.16**	269	269	252	223	191
29	0.61	0.44	0.08	0.00	0.00	187	169	138	116	113
30	0.83	0.72	0.70	0.68	0.33	232	223	221	207	178

Table III

Chemical Analysis and Physical Properties of Unheated Gray Cast Iron

(Series B)

Type of Iron	Series No.	Size bar "As cast"	Tot. Carbon	Comb. Carbon	Graph. Carbon	Si	Sul	P	Mn	Ni	Cr	Brinell Hardness	Transverse —Test— Load	Deflection	Tensile Str.
High-test Iron, low-Carbon, high-silicon Nickel	31	1 in. x 2 in. x 26 in.	2.96	0.73	2.23	2.53	0.113	0.06	0.78	0.96	0.02	234	3,660	0.48	49,900
Low-Carbon, high-Silicon Chromium	32	1 in. x 2 in. x 26 in.	2.67	0.79	1.88	2.39	0.090	0.07	0.67	0.76	0.45	267	4,000	0.42	62,700
High-Carbon, low-Silicon	29	1 in. x 2 in. x 26 in.	3.63	0.73	2.90	1.15	0.091	0.17	0.54	0.03	0.03	184	2,660	0.53	32,800
High-Carbon, low-Silicon, Chromium	30	1 in. x 2 in. x 26 in.	3.46	0.87	2.59	1.36	0.085	0.39	0.68	0.015	0.54	227	3,110	0.46	41,900

speed of ¼-inch per minute. Tensile specimens pulled at high temperature were heated slowly and held at test temperature for 20 minutes before test was made.

The thermocouple was in contact with the center of the test specimen in the type of heating box used. Physical and chemical determinations were made on material from comparative locations in the various specimens. The test specimens in series *A* were cut into short lengths and the pieces placed in a container which was lowered into the furnace to a point near the base-metal couple leading to temperature recorder. In the *B* series, the test bars 26 inches long were set vertically in the furnace. As the furnace height was insufficient, it was necessary to build a well-insulated extension about 1 foot high. A small auxiliary heater was inserted near the top of the furnace to equalize the heat in top and bottom.

Temperature Examined

The temperature of the enlarged furnace was explored thoroughly by base-metal couples and found to be about 20 degrees Fahr. at about half way from top to bottom. This was adjacent to point of application of load in transverse test. As the tensile bars were taken next to transverse break and all other tests were made at this point, the temperature of this area was used as recorded temperature of test run. Most tests had been completed before the 20-degree difference in furnace temperature was discovered, otherwise tests at high temperature could all have been made at the temperature of the long-time heating. This would have avoided the two temperatures shown as heating and testing temperature in Table. IV. Transverse bars of series *B* were not part of the original program, but were suggested by a member of the American Foundrymen's association committee to determine whether the diminished load after heating was compensated for by an increased deflection. That was not found to be the case.

The method of ascertaining combined carbon was to determine the total carbon by combustion, the graphitic carbon gravimetrically and then to subtract the graphite from the total. The brinell and tensile tests and the majority of the carbon determinations were averages of two or more results. It may be noted that the combined carbon is sometimes not quite in line with the other tests. The combined carbon can be determined only by difference and may show the sum of two errors. It would appear safer to rely upon the brinell hardness and tensile strength to indicate the high temperature changes.

Physical Properties Drop

The bars of series *A* tested at 850 degrees Fahr. showed a slight drop in combined carbon, with little change in tensile strength and practically none in brinell hardness, at 900 degrees Fahr., there was a decided drop in combined carbon in all but series 3 and 4, the drop in those being much lower, not much change in hardness and considerable loss in tensile strength, but less in those specimens containing chromium, at 950 degrees Fahr., the action was continued with a loss in strength in all specimens but much less in series 3 and 4, which contain chromium, at 1000 and 1050 degrees Fahr., the softening and weakening action was further continued, and at 1050 degrees Fahr. freedom from combined carbon was found in all but the series containing chromium.

At 870 degrees Fahr., bars tested in series *B* showed a drop in combined carbon, with no change in brinell and only slight changes in transverse and tensile strengths; at 920 degrees Fahr., there was a decided drop in combined carbon, a drop in brinell in series 29 and 31, and also a loss of transverse and tensile strength in the chromium-free specimen; at 970 degrees Fahr., there was a large loss in brinell hardness, combined carbon and tensile and transverse strength in the series 31 and 29 while series 30 and 32 containing chromium showed much less loss; at 1020 degrees Fahr. both series 31 and 29 showed entire freedom from combined carbon.

As the combined carbon diminished the strength and hardness of all the series continued to fall off up to the maximum test temperature. The transverse bars heated at high temperature seemed to average a little lower in deflection, which checks results obtained by the authors in 1922. The surface of these bars may have been slightly effected by the hot gases.

In addition to making tensile tests of the annealed material at room temperature in series *B*, tensile tests were also made at the temperature at which these bars had been previously heated. The purpose of this test was to determine the tensile strength of any iron in service at a given temperature after a 500-hour hold. Tensile tests also were made at elevated temperatures of the unannealed material, as shown in Table IV.

Tensile Data Given

Series 31, Table III, broke in its *as cast* and untreated condition at 49,900 pounds per square inch. That material lost approximately 25 per cent tensile value on heating 500 hours at 920 degrees Fahr. and pulling at a temperature of 900 degrees Fahr., while heating 500 hours at 1020 degrees Fahr. and pulling at 1000 degrees caused a loss of nearly 57 per cent of its tensile strength. Series 29 lost 22 per cent after heating at 920 degrees Fahr. and 54 per cent after heating at 1020 degrees Fahr. In the series 30 and 32, both containing chromium, the loss was not as great. Series 32 lost 13 per cent after heating at 920 degrees Fahr. and 36 per cent at 1020 degrees Fahr. Series 30 lost 13 per cent at 920 degrees Fahr. and 32 per cent at 1020 degrees Fahr. Losses of this magnitude must be taken into consideration when designing parts which must operate at elevated temperatures.

Micrographic examination of specimens of series 1, 2 and 11 showed that there was no difference in structure before and after the treatment at 850 degrees Fahr. Micrographs taken after heating at 1000 degrees Fahr. showed an almost complete decomposition of the pearlite, while those taken at 1100 degrees Fahr. showed a structure completely free from combined carbon.

In the series 30 and 32, no change in structure was found at 870 degrees Fahr. and even after the 1020 degrees Fahr. treatment a considerable percentage of combined carbon still remained.

Starting with typical pearlitic structures in all irons, micrographs showed a progressive disintegration of the eutectoid into graphite and ferrite, graphite apparently migrating to the existing graphite plates, while the ferrite areas grew as the annealing temperatures increased. The lessening pearlite usually was found adjacent to the graphite flakes which became swollen in size and fuzzy in appearance.

It might be interesting to note several instances of the effect of long-time operation at high temperature. A marine diesel engine liner of European manufacture, which had been in operation four years and was removed on account of wear, showed the following analysis: Graphitic carbon, 2.10 per cent; combined carbon, 0.76 per cent; total carbon, 2.86 per cent; manganese, 0.36 per cent, phosphorus, 0.56 per cent; sulphur, 0.126 per cent; silicon, 2.21 per cent; chromium, 0.46 per cent and nickel, 0.73 per cent; with a tensile strength of 29,300 pounds per square inch and brinell of 202. The structure was originally lamellar pearlite. Part of the cementite veins in the pearlite had become spheroidized, probably due to temperature of operation. That action took place even though chromium was present and may have been due to the high silicon.

A gas engine liner after four and one-half years or 37,879 hours of actual operation, which was not removed because of wear showed the following analysis: Graphitic carbon, 2.42 per cent; combined carbon, 0.73 per cent; total carbon, 3.15 per cent; manganese 0.86 per cent; phosphorus, 0.34 per cent; sulphur, 0.115 per cent; and silicon, 0.96 per cent, with a tensile strength of 34,250 pounds per square inch and a brinell of 197. At a magnification of 500 diameters, there appeared to be no breaking down or change of the pearlite due to temperature of operation but examination at 2000 diameters showed traces of spheroidization.

A gas engine liner after 17 years' service showed the following analysis: Graphitic carbon, 2.58 per cent; combined carbon, 0.80 per cent; total carbon, 3.38 per cent; manganese, 0.58 per cent; phosphorus, 0.45 per cent; sulphur, 0.108 per cent and silicon, 0.75 per cent, with a tensile strength of 32,600 pounds per square inch and a brinell of 177. The structure at 500 diameters showed traces of spheroidized cementite, and it was apparent that a slight softening had taken place. There was some wear but it was removed for other causes. Estimates of the temperature of opera-

(*Continued on Page* 111)

Table IV

Tensile Strength of Gray Cast Irons After 500 Hours of Various Heat Treatments

Intermittent Treatment

(*Series A*)

Series No.	Heating to Temperatures, degrees Fahr. 800	850	900	950	1000	1050	1100
5-6	62,500	62,600	58,700	54,100	45,600	.....	.....
28	.....	.....	56,400	.....	.....	.....	38,100
9	.....	.....	54,200	53,100	48,200	38,700	.....
11	.....	64,000	64,800	56,200	48,000	43,000	41,500
8-10	.....	.....	52,400	45,100	.....	.....	.....
1	32,750	32,350	32,850	29,150	23,350	20,700	20,900
14-26	.....	29,000	28,800	26,000	21,750	19,050	17,200
23	.....	.....	33,000	.....	.....	.....	21,900
2	34,600	35,100	34,650	28,500	23,550	22,200	20,550
3	37,000	37,550	35,250	36,950	29,500	26,950	24,250
4	42,550	42,200	44,000	41,450	41,800	36,750	33,600

Continuous Treatment

(*Series B*)

Tested at High Temperatures

Series No.	Heating Temperatures, degrees Fahr. 870	920	970	1020	1120
	Testing temperatures, degrees Fahr. 850	900	950	1000	1100
31	45,400	37,600	28,550	21,600	17,100
32	60,400	54,500	49,300	40,100	25,700
29	29,900	25,400	19,700	15,000	12,650
30	40,000	36,450	34,700	28,150	19,800

Tested at Room Temperatures

Series No.	Heating Temperatures, degrees Fahr. 870	920	970	1020	1120
31	50,900	47,350	37,750	33,300	31,500
32	65,600	62,600	61,000	57,200	48,200
29	32,700	30,700	24,600	21,900	20,000
30	41,800	41,700	39,200	38,900	32,000

Tensile Strength As Cast at High Temperatures and Transverse Strength Heat Treated

(*Series B*)

Tensile Strength

Series No.	Testing Temperatures, degrees Fahr. 850	900	950	1000	1100
31	45,500	43,150	40,600	37,000	28,300
32	60,650	56,300	55,500	50,700	38,800
29	30,800	29,100	27,200	24,800	19,800
30	40,200	38,400	36,600	34,200	25,800

Transverse Tests

Series No.		Heating Temperatures, degrees Fahr. 870	920	970	1020	1120
31	Load	3,520	3,350	2,990	2,760	2,570
	Deflection	0.47	0.46	0.47	0.44	0.43
32	Load	.....	3,700	.....	3,760	3,400
	Deflection	.....	0.37	.....	0.38	0.42
29	Load	2,630	2,470	2,190	2,050	1,870
	Deflection	0.51	0.45	0.45	0.48	0.43
30	Load	3,070	3,080	3,220	3,150	2,720
	Deflection	0.42	0.47	0.50	0.48	0.55

The FOUNDRY Family Photograph Album

Upper Left

G. R. KITTLE

Ohio Malleable Iron Co., Columbus, O.

Upper Right

O. B. MUELLER

Mueller Brass Co., Port Huron, Mich.

Lower Left

G. H. CLAMER

Ajax Metal Co., Philadelphia

Lower Right

G. F. NYE

Dobbie Foundry & Machine Co., Niagara Falls, N. Y.

HOW TO MAKE A SIMPLE BLAST GATE

(*Continued from Data Sheet No. 830*)

tack-welded at *T*, Fig. 1, preheating the upstanding legs to a full red at the corner before starting to weld at *B*. The flame should be directed toward the bottom of the angle.

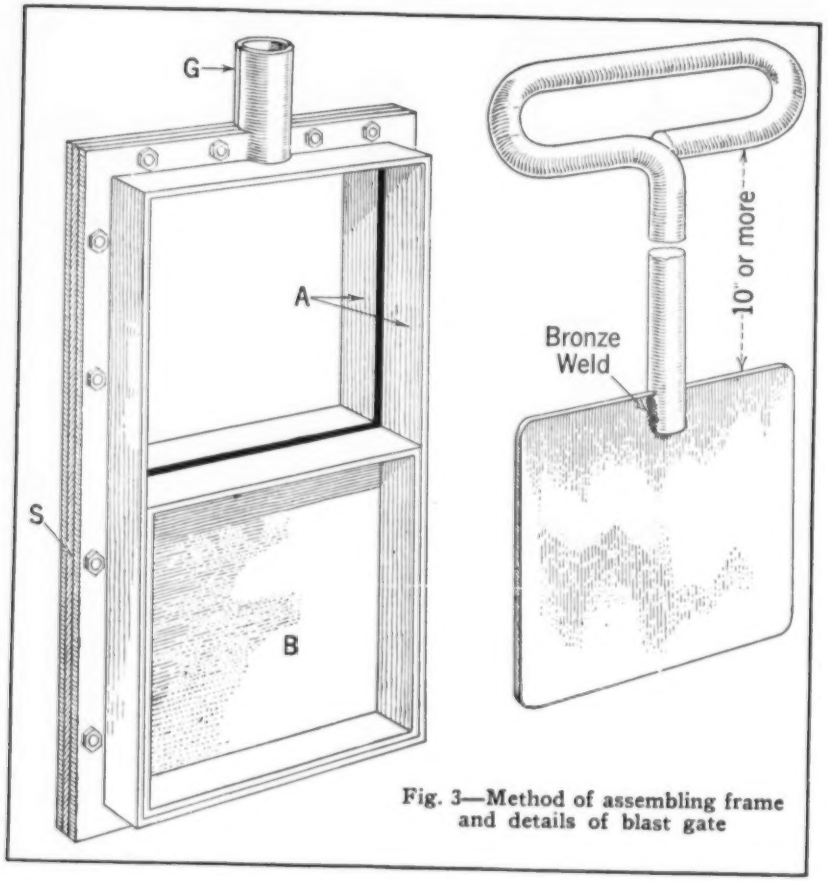


Fig. 3—Method of assembling frame and details of blast gate

One bulkhead *B* is required for the bottom of each main frame. It is a square pan made of 10 or 12-gage sheet metal, exactly 8 inches square out-

(*Concluded on Data Sheet No. 832*)

HOW TO MAKE A SIMPLE BLAST GATE

(*Concluded from Data Sheet No. 831*)

side, and its sides 1½ inches deep. It is easily made of a square of metal 11 inches on one side, Fig. 2, each corner notched square to the bending line for the 8-inch bottom. After turning up the four edges, weld the corners. When properly made the bulkhead should be a gentle force-fit into the lower part of the main frame, and the inner surface should be exactly flush with the back of the angle iron. To insure tightness run a bronze weld rapidly around the outstanding legs.

Next the spacer frame should be made of ⅛ x ¾-inch bar, welding the corners square. Its dimensions should be 11 x 19 inches outside (to match the main frame) and 9½ x 17½ inches inside to give a little clearance to the gate.

Fig. 3 shows the assembly of the two frames *A* and the spacer *S*. A gasket of heavy manila paper should be inserted on both sides of the spacer. Surplus weld metal on the surface in contact should first be removed carefully, and each member flattened against a true plane to remove any wraps from the welding heat. When the frame is correctly assembled, a series of 9/32-inch holes, spaced about 3½ inches centers, is drilled near the edge of the outstanding legs, and the parts bolted together with ¼ x ¾-inch bolts.

Meanwhile the gate has been constructed of a piece of ⅛-inch brass plate, 9½ inches square. Notch the top center ¾ inches deep, and bronze-weld a handle made of ½-inch cold rolled steel bar to it.

The gate is now complete except for the guide *G* for the handle, Fig. 3. This is a piece of ⅜-inch gas pipe, ½-inch actual internal diameter, 2½ inches long, cut lengthwise with a hacksaw. A place for it is cut from the exact center of the top rail and the two halves welded in place and to accurate line with bronze welding rod. Then run a reamer of proper size through the pipe so that the handle will slide through easily without binding.

To mount such a gate on an 8-inch square duct, it is only necessary to fix the pipe ends into the upper opening, place the gate in position, and bolt the two ends together. The manila paper gasket gives enough play so the gate slides easily, yet little clearance for air to work around the edges when the opening is closed. No leakage to the outside is possible except through the handle guide, and this purposely reamed to a snug fit. To open the passage, the handle is pushed in, and the gate drops into the pocket between bulkheads; a close fit between the sliding gate and the edges of the guides *A* prevents dirt from falling into the slot. For that matter, the handle can be turned toward any side where operation is handiest, sideways or even downwards. The sliding gate, being of brass, will not rust and stick to the frame after having been inoperative for some time.

To adapt such a frame to odd-shaped and smaller pipes, it is only necessary to blank off the opening with the square steel sheet, welded to the outstanding legs of the angle. Then cut a hole of the correct size in this and weld in the pipe.

THE FOUNDRY DATA SHEET, OCT. 1, 1930

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Believe It or Not—
The Foundry Industry Needs *The Technician*

By E. O. Keator

WHILE it is generally accepted today that machinery, and materials processed by machinery, both being amenable to well known physical and chemical laws, can be best controlled and manipulated by technicians educated and trained for the purpose, there still remain a few benighted souls who have not yet reached that stage. Although practically all successful industries keep technicians in their employ to apply scientific principles, to their manufacturing process, foundrymen consider an occasional chemical analysis about the limit of the technician's capacity to assist and his efforts are not encouraged along so-called practical lines. The result is, that while no industry is more basically necessary than the foundry, none is so deep in the throes of despondency.

Must Solve Problem

The malleable castings industry has lost considerable legitimate business to pressed steel and is an outstanding example of what happens when an industry scorns the assistance of the engineering technician. It is a pity that those on whom this calamity has fallen seem incompetent to analyze the problem or cope with it.

In some cases it was the smoother and neater finish of pressed steel that brought about the substitution. However, by using proper sand and molding methods, and tumbling the castings with steel shot, leather scraps and hardwood splinters instead of hard iron stars, a finish equal to or better than that of pressed steel can be imparted to malleable castings with small extra cost.

A manufacturer of automobile steering wheels formerly used in excess of 5000 malleable spiders daily, but substituted pressed steel when it was found that buffing operations required to make malleable presentable cost 10 cents each.

In the majority of cases, pressed steel is substituted simply because it is considered cheaper than malleable iron. This might seem strange in view of the fact that steel plate delivered at the press costs approximately 3 cents a pound while iron at the spout at the malleable foundry costs less than 2 cents a pound. As a matter of fact, pressed steel is not essentially cheaper than malleable castings, but merely happens to be so because of the crudities and wasted effort prevailing throughout the entire process of making malleable castings which, on the average, doubles the production cost. Much of the same handicap applies to all ferrous and nonferrous castings.

It would seem, that in view of the extremities to which foundrymen have been forced, they would study the situation carefully to get at the root of the trouble, ascertaining the cause and applying corrective remedies. Some have done so but others have folded up, instead of fighting back with the same weapons that have licked them so far, viz., scientific methods.

Practically everything written of a derogatory nature concerning technicians has been inspired by the actions of young inexperienced graduates, and particularly those placed among unfamiliar surroundings, devoid of leadership competent to direct them along useful lines. Anyone should know that a boy just graduated from technical school is no more qualified to solve foundry problems than the recently graduated law student is to try cases before juries, with seasoned lawyers as his opponents. This is true with all professions. Years of study and reflection along with his daily work are necessary before the technician can size up a situation and correctly apply the rules, laws and principles with which he became slightly acquainted at college.

Mature Technicians Needed

The foundryman must take stock of himself and find out why he has no one in his organization competent to apply scientific principles to practical problems. He can rest assured that just as soon as he makes it worth while for the mature technician to assist him, competent technical supervision will be forthcoming. However, he must realize that there are fakers in all lines of human endeavor, and that there is no such thing as long-distance technical supervision. It can be applied only in person and right on the job, for what is not positively known cannot be given honest endorsement.

Only sporadic attempts have been made to operate foundries along scientific lines, so no one really knows to what extent economies can be affected by doing so. The idea is so little understood among foundrymen that they cannot disassociate it from the belief that it implies increased production costs, whereas it should imply the opposite. As long as men are in business for profits, a certain balance must be maintained among the three vital factors, quality, workmanship and price, and whatever that relation is, it can be reached and main-

Thought Provoking

WHEN Professor Beese, then head of the industrial engineering department, Pennsylvania State college, State College, Pa., asked his now famous question last spring regarding the advisability of teaching foundry practice as a part of an engineering course, he started a discussion which has extended far beyond the campus atmosphere into many phases of the foundry industry. Many of the interesting and valuable discussions have been presented in THE FOUNDRY *since the first of the discussions was published in the March 15 issue. This contribution was prepared for presentation in the section known as, Reader's Comment, an open forum where thought and opinion not necessarily agreeing with the thought of* THE FOUNDRY *finds place, but due to the length of Mr. Keators expression, it is presented as a feature article. Many leaders of the foundry industry may not agree with the arguments set forth. Many may consider the ideas which he has presented as being rather advanced. The discussion is presented in the hope that it will provoke further thought on this important problem facing the foundry industry.*

tained best by the application of scientific methods.

Foundrymen should learn to think more logically. As a general proposition, claims made by any one foundryman of a material superior in quality to that of his competitors who are making the same class of castings and are members of the same trade organization, do not impress buyers favorably. Other members make the same claims. If the buyer does not actually discount them all he expects the same high grade material from all as a matter of course, hence nothing is gained but a bad impression from advancing this argument for overcoming sales resistance. The foundryman should do as others have found necessary. He should pin his hopes for profits on new methods for effecting economies without lowering the grade of his product. This inevitably means scientific supervision of manufacturing processes and the adoption of a practical plan for rewarding individual workers substantially for valuable suggestions.

Factors Must Be Studied

Machine molding was introduced a generation ago, and in the natural course of events it could have been expected that all the factors affecting machine molding would be studied scientifically to get everything possible out of the method. Such a study would have involved segregating the various factors, trying them out to determine their effect, first alone and then together and from the results establishing the best possible technique. However, after 30 years of machine molding, foundrymen have not yet even located the controlling factors that affect the problem, much less calibrating them or affixing numerical values so necessary to prevent repeating mistakes. They do not recognize the necessity for research work of this kind. The practical foundryman's idea of operating a foundry successfully is to hand a pattern to a strapping negro molder, point to a molding machine and say "Here you are George, now make the sand fly."

But George isn't doing so good. It requires more than a strong back to compensate for 5 to 10 per cent molding loss, the maintenance of batteries of grinding machines, straightening hammers and operators, chippers and trimmers, a fleet of trucks for handling the castings back and forth for these operations, and a corps of inspectors, plus the overhead cost of all this unproductive labor used solely for correcting defects that are neither necessary nor unavoidable. Scientific methods must be adopted, first, to find ways of eliminating the defects that make unproductive labor necessary; second, when such ways are found to build up a technique from them to speed up production. Harry Dietert, and other sand control experts, have laid the foundation for this technique, for without the benefit of their labors which are made available to all through sand calibrating instruments, consistent results with the other factors would be impossible. This is the second factor that can be removed from the list of unknowns. The first is the ability of the present day metallurgist to prepare mixtures that assure consistent properties.

While foundrymen will not admit it, molding machines are much of an unknown factor in machine molding. Hand squeezers act differently from power squeezers; jolt ramming has a different effect on the sand from that of both squeezing and hand ramming. Squeezer machines turn out more molds a day than other methods of ramming sand, but are prone to make defects on the castings as the result of spots of different densities throughout the mold which result in washes, ramoffs, swells and fins. Most foundrymen being unaware of this peculiarity of sand rammed with squeezers are unable to diagnose their losses, which of course is a severe handicap to any efforts toward systemization. The subject of molding machines is one that should be given careful, scientific study, the results classified and made available in practical form for foundry workers. Inevitable benefits of this would be an increase in production double or treble that of present-day standards and far neater castings.

Patterns constitute another unknown factor. It goes without saying that patterns first of all should be accurate inasmuch as it is impossible to make accurate castings from inaccurate patterns. Nevertheless the majority of production patterns are inaccurate. The majority of inaccuracies are found in ordinary matchplate patterns and in both cast and pinned types. Most cast plates are thinner at the center than the outside, sometimes by as much as 1/16-inch or more, causing the defect in castings known as *crush*. Cast plates of the ordinary variety also become inaccurate through distortion from shrinkage while solidifying, and the result often shows up in the castings as *shift* and *ramoff*, although strictly speaking it is neither.

Some foundrymen are suspicious of cast plates but all seem to have an absolute belief in the accuracy of split pattern plates where the cope and drag halves of the patterns are cast separately and then attached to a rolled metal plate by pinning. This type of pattern will eliminate *crush* but it will not eliminate that defect in the castings which somewhat resembles true *shift*, where the cope mold has moved laterally on the drag mold before the iron was poured.

The foundryman acquires this faith in pinned pattern matchplates through conclusions reached from loosely made observations and his inability to check patterns accurately. He assumes that if two halves of a pattern are clamped together with the edges flush and drilled for pinning holes cope and drag of the pattern must register after the halves are pinned to opposite sides of the plate. This procedure includes first laying one half of the pattern face down on the drill press and drilling the pinning holes for this half, then clamping the two halves together with edges exactly flush and using the first set of holes drilled as guides for drilling the pinning holes in the second half. The impossibility of drilling *straight* holes by this method causes the trouble. The unsupported drill always will bend more or less under the pressure of the feeding lever and resulting holes will be oblique with respect to the face of the pattern instead of perpendicular. This, of course, prevents cope and drag from registering, causing what closely resembles true *shift* on the finished castings.

Such castings are unsightly and sometimes cannot be used. For example, in sprocket chain links the *shift* quickly increases the diameter of the stock so that the links cannot be connected. In the many cases of this kind, hand patterns are resorted to, with a tremendous slowing down in production. In other cases where the defect is objectionable only because of appearances, quack remedies are used which are funny, except to the customer paying for them.

Remedies Ineffective

The foundryman concludes the trouble with the accuracy of the pinned pattern is caused by the sand slipping on the plate. This is true under certain conditions with squeezer machines. To prevent it he has devised various methods of roughening the plate. One of these consists in stipping both faces with thousands of tool marks made by striking a pointed punch with light blows of a hammer. A second is the "offset" plate which gives the parting faces of the mold a dished effect to prevent lateral movement. A third is the *button* effect where similar but smaller dished impressions are made between patterns and around the edge of the plate. Still another is the placing of one or more small *dams* or *dykes* on the plate opposite certain spots on the pattern where the defects appear worst on the castings. Of course *remedies* of this kind cannot do a particle of good but the customer pays just the same.

Another source of constant trouble and expense of which the practical foundryman is blissfully unaware but which helps to keep his crews of trimmers, grinders, straighteners, truckers and inspectors busy, is the white metal he uses for reproductions off the master pattern from which to cast the aluminum production patterns. This metal shrinks approximately 1/16-inch per foot with solidification.

In the case of cast plates having cored patterns, and pinned pattern plates with cored patterns where the white metal is used, the trouble produces a discrepancy between the dimensions of the core and those of the matrix made by the pattern, and is explained as follows: To make the core box, a plaster of paris cast is made off the core print on the master pattern. When hardened, the cast is trimmed down to the desired thickness for use as a pattern from which to produce the corebox in aluminum. This in turn, is used for making sand cores. These sand cores are smaller than the core print on the master pattern by an amount equal to the shrinkage of aluminum which is ¼-inch to the foot, whereas, the matrices are smaller by an amount equal to the shrinkage of aluminum plus that of the white metal which is a total of 5/16-inch per foot hence the prints are too small to receive the sand cores.

Loose Sand Causes Wash

It is necessary then, for the molder to force each core down into the sand to prevent the cope resting entirely on the cores and distorting the mold. This breaks sand loose from around the edges of the core. The sand floats into the metal causing dirty castings and leaving cavities into which the metal runs and produces fins and snags on the castings which must be removed in the trimming and grinding departments. Usually the castings are damaged by these operations much to the irritation and disgust of the customer. The substitution of nonshrinking white metal for the ordinary kind used eliminates the trouble.

It might be inferred from the foregoing that accurate patterns are impossible of attainment, but such is not the case. Some people have always recognized them as a necessity and developed means of producing them. One method is a semi-die casting process where the metal is poured into hard plaster molds under air pressure. Another uses an electro plating process. Still others consist of various artificial stones. Patterns made by these methods are advertised in each issue of THE FOUNDRY. Accurate patterns, while by no means a cure-all, are cheap at any price.

These are but a few examples of the foundryman's unsolved problems that, to technicians, stand out like beacons in the night. Under the circumstances it is useless for the foundryman to shut his eyes to the fact that the public has good reason for its deep-rooted distrust of castings, or even to protest that this feeling is an unjustified prejudice handed down from the days of unscientific mixtures of metals, because under conditions in vogue at most foundries today the best and successful efforts of the metallurgist to produce genuinely scientific mixtures are often partially or wholly nullified by destructive factors innocently introduced by so-called practical workmen. The gating of castings for proper feeding is a case in point, for there are certain metal mixtures whose strength and ductility often are reduced as much as 50 to 75 per cent because of unscientific gating. Even the excuse often heard that patterns made outside the foundry cause the trouble is nothing more than an admission of guilt.

Many customers spend more money truing up a considerable proportion of their castings, deformed in one way or another in the process of manufacturing at the foundry, than they paid the foundryman for them in the first place. No one expects castings to be accurate and as it is difficult to draw the line between scrap and passable work, and human nature being what it is, practical foundrymen have been prone to crowd many of the sins of the foundry on the customer and make him feel that it is all a legitimate part of the game. In the meantime the pressed-metal people and manufacturers of forgings, through their own technicians consulting with technicians of the customer, get together and by changing the shape of the product adapt it to one or the other of these processes of manufacture. The foundryman's position is weakened every time this happens.

All of these things and many more that can be mentioned, should indicate clearly that something must be radically wrong with the foundryman's methods and that he must do something to stem the tide of anti-castings mindedness among buyers or face a black future.

He may believe it or not, but just as surely as his competitors have outdistanced him through turning to the technician for scientific help, there lies his hope. There are technicians available now who can assist greatly in turning out consistently the highest grade of material who can assist in turning out castings truer to shape by machine molding than is possible in any other way, and who, by combining the advantages possible through scientific manipulation of machines and materials, can reduce production costs substantially. But the foundryman's best hope lies in taking on young technical graduates and admonishing them to learn the old foundry methods thoroughly, but only to improve and not perpetuate them.

A series of six aquatint etchings is being distributed by Jenkins Bros. Co., 80 White street, New York. The etchings, 11 x 9 inches in size, illustrate scenes in the manufacture of Jenkins valves. The etchings include: Strength test, pouring molten bronze, foundry casting, machining, gaging operation and testing. A description of the operation illustrated, is attached.

Long Heating Periods Affect Gray Iron

(*Continued from Page* 106)

tion of the above liners are known but no definite tests have been made. The spheroidization of the cementite veins in the above structures is interesting, and in these few cases is in proportion to the amount of wear shown.

Only the most general conclusions may be made and the authors caution against making too many definite deductions upon the comparatively few tests made. It would seem that high silicon materially accelerates the decomposition of the pearlite, and that nickel does the same, although not to the same extent. Low silicon and low carbon with finely divided graphite flakes tend to delay that action. Chromium decidedly increases tensile strength at room temperature and delays decomposition of pearlite. It also operates to retain the strength at high temperatures.

The tests are instructive in showing a low tensile strength at elevated temperatures. The best results were obtained from the series containing chromium. It would seem that heat-resistant iron cannot be made by running on low carbon with high silicon and nickel to promote fluidity and machinability, but that a low-silicon, low-carbon iron is much to be preferred and that the addition of even 0.5 per cent chromium greatly increases the stability of the carbide and the strength at high temperature.

European Practice Is Outlined

In many foundries in Europe, an iron with less than one per cent silicon and about three per cent carbon is being made. This iron, when poured into small castings, would ordinarily be too hard to machine. The practice there is to pour the metal into molds which are preheated to a high degree. This produces a much slower cooling and leaves the castings in a machineable condition. A pearlitic structure is desired.

Castings of this type often are used where a minimum growth is essential. All the conditions favoring a low growth are present, and the castings are probably as free from growth as any gray iron castings can be. It might be of interest to note that all liners previously described were made with an entirely peariltic structure but not by the hot-mold process. It should be remembered that there is nothing in these tests, even at 1120 degrees Fahr., which would indicate that the maximum effect of heat at that temperature had been reached.

The brinell tests in series *A*, table II, show that, when running at those temperatures, there is a progressive loss of brinell from one week to the next. On several series there is a continued loss in tensile strength and brinell hardness, even after the en-

tire decomposition of the carbide has been accomplished. It is quite possible that a longer time at the higher temperatures would both soften and weaken all the material tested. A second 500 hours heating at 950 degrees Fahr. of series *B* bars caused slight further losses in both the chrome-free series, but not in either of the two series of bars containing chromium.

Mandatory Goggle Rule Protects Eyes of Workers

By Harry Guilbert

THE National Society for the Prevention of Blindness estimates that eye accidents cost American industries $50,000,000 a year. According to the annual statement of the bureau of workman's compensation, state of Pennsylvania, over $11,000,000 was paid out in compensation for eye accidents from 1916 to 1929 inclusive.

There is only one method of preventing these sad occurrences and that is by enforcing the universal wearing of goggles by industrial employes. Today men are carefully fitted, and when one compares the type of goggles used in former days with that of today, one wonders why any intelligent workman should object to wearing them. After having tried for years every conceivable method to persuade men to guard their sight, with little if any success, I arrived at the conclusion years ago that there was only one way to prevent these deplorable losses, namely, the universal, mandatory wearing of goggles.

Five years ago the management of the Pullman company issued instructions that everyone must wear goggles while on duty, and, as a result, it is nearly 5 years since the last serious eye injury occurred.

The following notice signed by the president hangs at the entrance to every Pullman repair shop:

> "Officers, supervisors and employes of the Pullman company will please wear goggles when entering the shops. The gate-keeper will provide goggles when necessary."

The mandatory ruling is responsible for the good record in so far as eye losses are concerned. In the past many men were discharged and disciplined for ignoring the rule, but today we have little trouble along these lines.

Some companies insist that goggles be worn at occupations hazardous to the sight; in fact, they designate these occupations. What kind of job may one engage in that is immune from accidents to the eyes? For instance, in many foundries men on the chipping floor must wear goggles. How about visitors and men passing by?

A universal mandatory ruling means just what it says. Everyone is included, from the manager down. Shop superintendents at the Pullman company never would think of walking through the plant without wearing goggles. A superintendent once said he would much rather walk through the shop without shoes than without goggles.

The records of the Pullman company show that 94 eyes have been saved in the past four years. The savings in compensation and medical expense is estimated at $184,000, not including loss in wages. A careful analysis indicated that the money invested in the purchase of goggles for 2 years yielded 360 per cent in dividends.

Steel Men See Pickup

(*Concluded from Page* 98)

ed at the meeting of the small castings division. Walter A. Dorsey, Alloy Cast Steel Co., Marion, O., presented a paper on "Selling Steel Castings to Engineers." Mr. Dorsey pointed out that steel foundries in general have considerable information, which, if known to designing engineers, would result in the elimination of many weird casting designs. He pointed out that any plan of education must include the young man in the technical schools.

George H. Friesel, United Engineering & Foundry Co., Pittsburgh, presided at the meeting of the large castings division. After discussing "What Earnings per Sales Dollar Are Necessary in the Large Steel Casting Business?" the group listened to a discussion of the accounting and cost plan of the society by H. S. Bartholomew, consulting head of the cost engineering department and R. L. Collier, assistant managing director of the society.

Dr. Fritz W. Meyer, foundry consultant, metallurgist and vice president, Mississippi Valley Research Laboratories, St. Louis, sailed for Europe on the S. S. STATENDAM Sept. 13. He will visit his father who is director and manager of the Sulzer Diesel Engine Works, Wintherthur, Switzerland. After a short vacation, Dr. Meyer will tour European countries investigating foundry developments in both the ferrous and nonferrous industries.

Readers Comment

TO THE EDITORS:

I am interested considerably in the foundry problem which appeared on page 156 of the June 1 issue under the heading "Chilled Roll Cracks." I have brought this question up at the meeting of our local foundrymen's club, but without favorable results. Men who are engaged in the casting of chilled wheels and rolls admit that they are confronted with the same difficulty. My experience has been that often chilled rolls and traction wheels develop chill cracks on the face through the depth of chill whereas corrugated rolls or sprockets do not. I often have seen traction wheels poured out of one ladle of iron, shaken out while the castings were cherry red and thrown into the annealing pit. The wheels were annealed with the aid of a charcoal fire and cooled gradually until next morning. When the wheels were removed from the annealing pit, some of them developed chill cracks on the face.

In the case mentioned in the question published, I may say that the chill crack is not due to the extremely hard core, but entirely due to the mixture of iron. The mixture recommended, to my belief, will not answer the purpose. It will not give the proper chill. The sulphur will be too high and the manganese too low.

The roll casting probably will develop more chill cracks on the face, and the working surface of the chill will wear out fast. In the case mentioned I suggest a mixture of 50 per cent pig iron, 30 per cent steel and 20 per cent foundry returns, and if possible employ charcoal pig iron for one-half of the suggested amount of pig iron. The analysis should be held within the following limits: Silicon, 1.5 per cent; sulphur not over 0.110 per cent; manganese, not under 0.66 per cent and phosphorus, as low as possible. That mixture will give a chill from ½ to ¾-inch deep. The casting should be left covered in the sand until cool enough to handle.

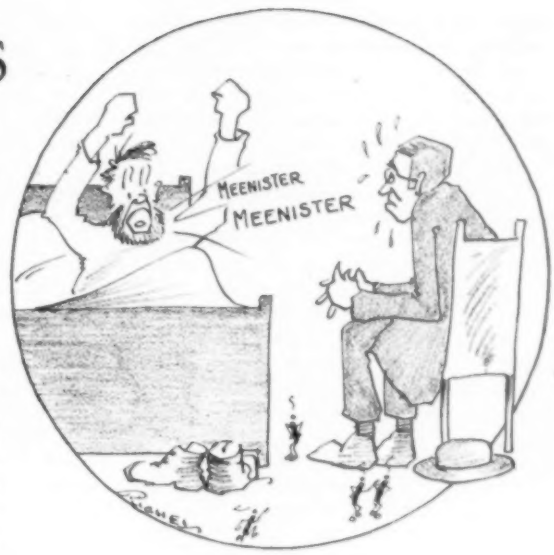
A. SILBERT

Chicago

Make Personnel Changes

Independent Pneumatic Tool Co., 600 West Jackson boulevard, Chicago, has transferred W. A. Nugent, formerly manager of the St. Louis office, to the Chicago office and F. J. Passino, formerly manager of the Pittsburgh territory has been transferred to St. Louis. T. J. Clancy of the Cleveland office has been appointed manager of the Pittsburgh office to succeed Mr. Passino.

Bill Talks Weapons and Small Cupolas



By Pat Dwyer

IF I HAD the time," Bill remarked the other night, "and the price," he added as a gloomy after thought, "do you know what I should like to do?"

"No," I replied, "and if you want an honest, straight forward and unbiased opinion, I have not the slightest curiosity on the subject. However, since you have neither the one nor the other—I presume you refer to what is known in vulgar circles as oodles of both commodities—why do you worry?

"Also, furthermore and to wit, by what process of reasoning do you arrive at the conclusion that I should be interested? You remind me of the story of the dying Scotchman."

"The dying Scotchman?" Bill echoed in surprise, "you mean the lad who boarded a pay-as-you-leave car and died of starvation? What has that story to do with—"

"No. This was another lad. A venerable old gent who lay dying in his own bed in peace and comfort. The minister came to see him and without preamble of any kind asked him if he knew where he was going to go after he died.

"The old boy eyed him reproachfully. 'Meenister, meenister,' he quavered, 'is this a time to be askin' conundrums?' "

"The inventor of that story," Bill said, "should be sawing wood or picking oakum. He knows nothing of the Scottish race. If there is one thing more than another that a Scot knows definitely it is where he is going—either in this world or the next. Also he holds pretty definite convictions on where the other fellow is going! However, you are not Scottish. You are not dying—although at times I doubt if that applies from the neck up—therefore your futile attempt—get that, futile—your futile attempt to drag a red herring across the trail is nipped in the bud neatly and promptly. If I had the time and—as I said some time back—perhaps you remember?—if I had the time and the price, I should like to rig up a room of my own with all kinds of relics and curiosities, ancient and modern weapons, curious lighting fixtures and an elaborate collection of tobacco pipes. The wood work would be all dark oak with heavy beams supporting the ceiling. The mission style furniture would be finished in the same color with the seats and backs of the chairs upholstered in gorgeous dark red Spanish leather. A cunningly concealed drawer under each of the chair arms would contain the smoking materials. A handsome gooseneck lamp drooping over the back of my favorite chair would furnish the light while I dawdled through the pages of a book."

" 'Tis a noble dream," I admitted, "Before you wake up, will you kindly invite me over to spend a few hours in this haven of delight? At one time or another I have harbored a somewhat similar vision, but I never knew that you had any place in that old hard head for day dreams. What started you off on that tack? In other words, how come?"

"Well," said Bill, "I'll tell you. Several months ago, in a Sunday paper I saw a reference to a marvelous collection owned by an old gentleman in Massillon. Through a mutual friend I got in touch with him and he extended a cordial invitation to pay him a visit sometime in the future and look over the collection.

"That is one of the delightful features common to your true collector. He wants to share his pleasure with others. He would part with his right eye in preference to yielding up one of his treasures, but his prodigality knows no bounds in giving a visitor an eyeful—and an earfull—two ears full.

"He had spent the greater part of his adult life—and he now is over 70—in collecting the contents of his museum and naturally in the process he also accumulated the most marvelous fund of miscellaneous information. It just bubbled out of him in a perpetual stream during the three hours I basked in his company on a recent Sunday afternoon. I had two of my sons with me and they derived as much, if not more pleasure than I did from viewing the various objects and listening to the old gentleman's comments.

"Except for the space occupied by a table and a few chairs, one entire room in his house is filled with relics and curiosities. A former clothes closet is jammed with objects for which there is no room elsewhere. The greater part of the collection is housed in glass cases on the wall, extending from the floor to the ceiling, but a considerable number of miscellaneous objects are suspended from hooks in the wall spaces between the cases, while others are suspended from the ceiling. In his living room downstairs he showed us a number of weapons recently acquired from the heirs of a man who had brought them back from the Philippines at the close of the Spanish-American war many years ago. Several swords and knives—vicious looking whangers—were of native manufacture and certainly were a credit to the men who made them. The others had originated in Spain and had been taken to the Philippines in the good old days when every pagan was given his choice of a

Now, If He Only Had a Cage for These Three Birds—

cross or a crown. If he accepted the first he was allowed to work for his new masters without remuneration. If he did not accept, he promptly was crowned and his name was removed from the prospect list.

"As I held all that remained of a one time beautiful sword in my hand, my mind traveled through time and space to a smithy in old Toledo or Seville and I saw the cunning smith deftly shaping the blade on his anvil. Loving care and a craftsman's pride were hammered into the long blade destined in after years to stand on many a jam and foray between the wearer and a sudden and violent death.

"Even now 300 or 400 years later, with the ornamental material of the hilt lost through corrosion and with the blade narrowed and thinned through the same cause, when the point of the blade is bent back to the handle, and released, it springs back into its original position as straight and true as it did on the day the smith withdrew it from the tempering bath and subjected it to the same test. Opinions may differ on the effects of the Saracen invasion of Spain, but believe me, kid, the black boys knew a thing or two about tempering steel and the Spanish smiths were apt pupils. The collection also contained a couple of halberds. Do you know what a halberd is?" "A halberd?" "That's what I said, a halberd. Not a hellbird or a half breed, but a halberd. Have you any idea what it looks like?"

"A halberd?" I repeated weakly, "Why a halberd is a kind of a long ornamental pole with a heraldic device or something on top. It was carried by the front lad in a procession in the manner of a drum major leading a modern brass band. How's that for a stab in the dark?"

"Stab is good," Bill chuckled. "These here halberds sure were some stabbers. They were carried in the front of the procession for the simple and laudable purpose of opening a way through any opposing procession.

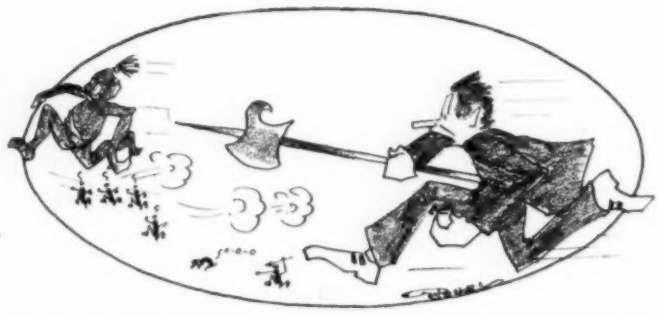
"The long wooden handle is fitted at one end into the socket of what may be termed a thin, double bitted, open work axe. One edge of the axe is convex and one edge is concave so that the wielder can catch his victim coming or going. The upper end of the concave edge is extended into a long, sharp curving point and the upper center of the axe is in the form of lance about 12 inches in length and keen as a razor.

"A stout, swarthy lad with one of these wicked tools in his brawny hands and with a slug or two of rum in his gullet could be trusted to open anything from a jackpot to a charging rhinoceros.

"The whistling blades of old Toledo made history in many a private fray and on many a stricken field. They maintained the honor of haughty don and caballero under the streaming folds of the scarlet and gold banner of Castile, afloat and ashore, at home or in the far parts of the earth. They were noble weapons, but they had not the range, sweep or deadly effectiveness of the keen edged, 12-foot halberds.

"A real tough guy, armed with one of those things could charge through a band of naked savages like a reaper through a field of standing grain. I imagine a highly skilled bird would experience a true craftsman's pride in leaving his victims lying in rows like a mower's swath at the close of day. All for the honor and glory of God, the crown and dignity of the King or Queen—and one peso per day!

"Recent history seems to indicate that, at least in one respect, mankind has not made any appreciable progress in the past 400 years. For



The Natives Perversely Refused To Become Civilized

example over in Europe a few years ago—"

"Never mind the moralizing and the weapons," I interrupted, "What else did you see in the collection?"

"Plenty," Bill said, "Plenty and then some. In a general way the collection is made up of four main groups of exhibits: Indian relics, souvenirs of early white settlers in Ohio, firearms and curiosities in general.

"The owner has made a profound study of Indian history and has drawn some interesting conclusions from what he has found in burial mounds, in fox burrows, under trees and rocks and from objects turned up by the honest husbandman, here and there while ploughing his land in the vain hope of finding farm relief.

"He showed me two objects to prove his theory that the first Indians in America came from Asia by way of Behring sea and Alaska. One of these objects was a jade ear ring and the other was a gold nugget. They were discovered in an Ohio burial mound near the skull of a squaw who—according to contemporary evidence—had departed for the happy hunting grounds about the time Columbus was claiming the record as the first man to make a transatlantic round trip.

"Col. and the lady—also the well known Judy O'Grady—for many centuries presumably have been living the life of Reilly, free from all earthly cares and troubles, but the ear ring remains, a tangible tribute to the skill of a Chinese artist.

"Centuries before the fabulous gold of the Klondike lured white men to the North, some wandering Ishmaelite picked up the nugget. Who knows through how many hands it passed, or by what devious trails it finally arrived at its last resting place in the grave of a forgotten Indian squaw.

"One of the most interesting objects is a banded slate pebble about the size of a duck egg with a ½-inch hole drilled accurately, approximately through the center. It was the property of a medicine man and was employed to decide important questions—according to the judgment of the aforesaid medicine man.

"Talk about loaded dice and other meritorious modern devices for skinning the proletariat! These old medicine men had their followers sewed up in a bag. The center of gravity in this stone is adjusted so cunningly that when the stone is laid upon one side it remains perfectly still. When placed upon the opposite side it rolls half over. To the uninitiated both sides appear exactly alike. The medicine man knows which is which. And how! With this magic talisman in his hands he can settle any argument that may arise from deciding an election bet to the advantage or disadvantage of going on the war path.

"Suppose the council is dead locked over a proposal to raid the enemies' country for a special purpose or just on general principles. The old boy decides in advance which way he wants the cat to jump, but he allows the gang to wrangle all night over the question. He does not take one side or the other but calmly announces that he will let the magic stone decide for them. They all gather around in popeyed wonder while he carefully places the stone on a level place on the floor.

"'Brothers,' he announces, solemnly, 'If the stone lies still, it is evident that the Great Spirit does not favor this expedition. If it rolls over, you can don the war paint and feathers in full assurance that you can belt the everlasting tar and tripe out of the enemy. Watch closely!'

"He releases the stone and the aborigines accept the verdict, even as you and I accept verdicts that have been thimble rigged in advance.

"Talking about Indians," Bill remarked, characteristically switching from one subject to another, "Reminds me of an inquiry I had recently from a man who lives out west in what at one time was the real Indian country.

"He wrote that his company was

contemplating the erection and equipment of a small foundry to supplement their machine and general repair shop. They did not expect to melt any great amount of iron at any one time and therefore were unable to decide whether a small cupola or an oil fired crucible furnace would be the more suitable for their requirements. They also expected to melt small quantities of brass occasionally. Oil does not cost much in that part of the country, but coke costs about $25 a ton. They have a shell which can be lined down to 18 inches.

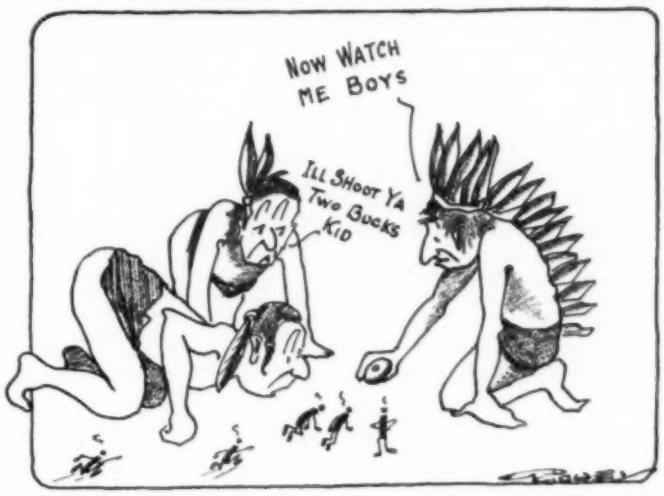
"In the event that the final decision was in favor of the cupola he would appreciate my advice on several points in its construction and operation. For example: The proper number and size of tuyeres and their height above the sand bed, the height of the charging door, the melting capacity per hour, the weight of the coke and iron charges, the size of the blower and other items which he probably had overlooked. No member of his company had any former foundry experience. The crucible furnace is the more flexible unit of the two and if these people want to melt a small quantity of metal at infrequent intervals, the crucible probably will suit their purpose better than a small cupola. However, for all I know to the contrary, they may have other plans involving the melting of iron in quantities beyond the capacity of an ordinary crucible. The following items in connection with the construction and operation of a small cupola were submitted for the inquirer's information.

"A cupola lined to 18 inches inside diameter has a melting capacity of approximately 1000 pounds per hour. The number and size of the tuyeres and their height above the sand bottom, are points that largely are optional and are decided by the personal experience of the man in charge of the melting. About 15,000 cubic feet of air are required to melt 1000 pounds of iron and therefore any set of tuyeres that will admit that quantity of air per hour, at a pressure of 4 to 6 ounces, will prove satisfactory. The six tuyere openings may be round or rectangular, 2½-inch diameter or 1½ x 3 inches.

"Many small cupolas are operated satisfactorily with only two tuyeres, set opposite each other, but an even distribution of the blast will insure more unifrom melting and is essential if the cupola is to be kept in blast over an hour. The height of the tuyeres above the sand bed is governed by the amount of metal designed to be accumulated in the well of the cupola before it is tapped. Probably 6 inches above the bed will be the most satisfactory in this particular case and for small heats.

"Iron and coke may be charged in the cupola in layers of 100 pounds of iron and 15 pounds of coke. The amount of coke on the bed will depend on the height of the tuyeres. A sufficient amount will be required to extend about 30 inches above the tuyeres after it has burned through and settled down.

"The coke should be broken to about egg size and the pig iron and scrap also should be broken in small pieces. Small iron is necessary for two reasons. The first and most important is that small pieces naturally melt faster and more readily than large pieces. This is only a minor factor in a large cupola where the fuel bed is large and the charge has ample time and opportunity to soak and acquire a high temperature before it enters the melting zone. In a small cupola where all the operations are carried through on a restricted scale, advantage must be taken of every feature that promotes efficiency.



Old Hole-in-One Peers into the Future

"The second reason for breaking the iron into small pieces is a precautionary reason to prevent a hang-up in the cupola shaft. A large or long piece of iron easily may become jammed and thus prevent the remainder of the charge from descending in a normal manner through the cupola.

"Where this takes place, the coke is consumed underneath without fulfilling its function of melting the iron above. Consequently when the piece that caused the jam is released later, either through gravity, or, by the application of a long bar inserted through the charging door, it falls on a low coke bed and either remains unmelted or melts at a temperature at which it is not fluid enough to properly fill a mold.

In addition to the crucible and the cupola, another type of melting medium is available, particularly in this instance where oil is comparatively cheap. This is an open flame tilting furnace made in several sizes, which has been advertised in THE FOUNDRY for many years.

Detroit Founders Meet

The first regular meeting of the 1930-31 term of the Detroit Foundrymen's association, was held Sept. 18 at the Fort Shelby hotel. Fred J. Walls, Wilson Foundry & Machine Co., Pontiac, Mich., chairman of the program and papers committee, was in charge of the discussion which centered around the new tentative A.F.A. recommendations for the operation of a 54-inch cupola.

Book Review

Annual Statistical Report of the American Iron and Steel Institute, published by the American Iron & Steel institute, New York, cloth, 9 x 6 inches, 119 pages; supplied by THE FOUNDRY, Cleveland, for $5.15, and in London by the Penton Publishing Co., Ltd., 416-17 Caxton House, Westminister, for 25s, postage extra.

The 1930 edition of the statistical report covers complete production figures of iron, steel, and related products for 1929 and preceding years. Figures and statistics given include those for steel, iron, ferroalloys, blast furnace operation, steel ingots and castings, rolled products, tinplate and galvanized products. Data on iron ore, coal and coke also are given as well as import and export statistics. Data relating to production in the principal foreign countries is continued in this year's volume. A section covering average prices of iron products is included. The information given is complete, concise, and bears the stamp of authority.

Talks to Foundrymen

Charles J. Scullin, general manager, Mississippi Valley Research Laboratories, St. Louis, addressed the first fall meeting of the New England Foundrymen's association, held Sept. 10, at the Engineers club, Boston. Mr. Scullin addressed the meeting on the various phases of cupola practice. Approximately 75 attended the first fall meeting.

Quad-City Group Meets

The regular monthly meeting of the Quad-City Foundrymen's association was held Sept. 15 at the Fort Armstrong hotel, Rock Island, Ill. A. A. Grubb, Columbus, O., addressed the meeting on the subject "Foundry Sands."

Joseph P. McGinnis has been appointed New England representative for the Sims Matchplate Co., Syracuse, N. Y., manufacturers of semi-die cast foundry patterns. His headquarters will be at Roxbury, Mass.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Time To Re-Vamp

AN unknown sage spoke the proverb: "How like a loose tooth, is a secret to a woman. She knoweth not whether to keep it or to spit it out; yet her tongue leaveth it not alone." How true this is of an obsolete sandblast, a worn out blower or a rickety molding machine that long ago should have been written off the capital account. When business is good many foundries feel that they cannot afford to shut down even an obsolete machine to make a change. When business is poor, some plants regard even badly needed plant improvements with disfavor. However, far-seeing manufacturers make changes in equipment in anticipation, realizing that at periods like the present prices are low and replacement can be made without the added burden of idle time charge. Now is the time to mend the roof before the fall showers of castings orders.

¶ Not Dead! Not Sleeping!

FOR several years foundrymen have been exceedingly interested in the competition offered castings by products made by other methods of fabrication, such as stampings, forgings and welded sections. The subject has been discussed frequently at various meetings with the result that individuals in the industry gradually joined one of two groups. One camp, carried along on a wave of pessimism, pictured the foundry rapidly fading, soon to join the historic group of lost arts. The second group, and happily the great majority, took a more optimistic view of the situation, and believed that the adverse reports, which being tossed about, might be just a trifle exaggerated.

THOSE attending the Chicago convention of the American Foundrymen's association in 1929, were interested greatly in several statements made by foundrymen connected with companies also producing built up structures of welded steel, designed to replace castings. One man stated that he believed the designers of machinery, in many cases, had been wafted along by changing styles and at that time had gone too far toward welded structures. He pointed out that many parts which now are made of welded steel would look better and be better if made of cast metal. Views of several other individuals attending that meeting agreed with that expression regarding probable trends in the industry.

Foundrymen will be interested in knowing that the predictions of these foundrymen, who were in a position to see both sides of the argument and to judge the problem on its merits, are coming true. Recent reports indicate several large companies that, during the past few years, swung heavily toward welded parts, now are bringing much of this work back into the foundry. One large manufacturer of electrical equipment is replacing welded structures with castings on its smaller line of equipment and now has a large crew of patternmakers at work rigging for machine production of castings. Another company, that at one time equipped one large foundry bay with welding equipment to make built up structures now has returned this floor space to the foundry and will use castings instead. Other instances showing the same trend could be cited.

Common sense and sound economies settle partisan arguments in industry. Foundry interests are *not* on the defensive.

¶ Long Service Assured

RECENT information obtained by the American Institute of Steel Construction, New York, has shown that structural steel will outlast the usefulness of structures in which it is used. Tests taken from beams, plates, and columns of the Waldorf-Astoria hotel, one of New York's old time buildings, which recently was wrecked to make way for a new towering skyscraper, show that decrease in physical properties was slight and that under similar conditions the life of the steel practically was indefinite. The previously mentioned building was built in 1891 so the basis of comparison covers a relatively short period when contrasted with the time that another engineering material has rendered excellent service.

CASTINGS have been made for centuries, and long periods of severe service form the basis of comparison in many cases. The slight amount of depreciation after thirty-nine years meets with a high degree of satisfaction in the steel industry. However, castings have withstood just as severe service for over a century. A cast iron pipe laid as a part of the Philadelphia water supply system in 1819 recently was dug up and found to be in good condition after 110 years exposure to corrosion and increasing pressure. Long and faithful service is fundamental to castings.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

G. P. MILLS formerly associated with the Duraloy Co., Pittsburgh, has been appointed director, chrome alloy department, General Alloys Co., Boston. After graduating from the University of Pennsylvania with B. S. and M. S. degrees, he spent several years in Panama on canal construction. Later he was transferred to Pittsburgh to inspect special steels for emergency dams at Panama. He next was identified with the bureau of water, Pittsburgh, and then became designing and sales engineer, Fort Pitt Bridge Works. Shortly after the Calorizing Co., Pittsburgh, was formed he was appointed sales engineer. He remained about a year and then became affiliated with the Koppers Co. on standardization work. He left the Koppers Co. to become identified with Duraloy Co.

Eugene Tetzlaff, vice president and director, General Bronze Corp., Long Island City, N. Y., has been placed in charge of the western division, with headquarters in Chicago, and will supervise its three plants in Chicago, Milwaukee and Minneapolis. He was president of Flour City Ornamental Iron Co., Minneapolis, which was merged with General Bronze Corp. last year. The Milwaukee plant formerly was known as Wisconsin Ornamental Iron & Bronze Co.

Charles A. Lynch, formerly manager of sales and engineering, Fort Pitt Steel Casting Co., McKeesport, Pa., has been made vice president and general manager, Foote Co., Inc., Nunda, N. Y. Mr. Lynch became connected with the Fort Pitt company in 1919 when he joined the sales department of that company. Prior to that he was affiliated with the Pittsburgh ordnance office as chief inspector, carriage division, in charge of inspection and manufacture of gun carriage components.

Earl L. White has resigned as manager, Gering Foundry & Machine Co., Gering, Nebr., to become foundry manager for the Nu-Way Casting Co., Council Bluffs, Iowa. Mr. White began his career in the foundry industry when he entered the Western Motor Co., Logansport, Ind., as an apprentice. He completed his apprenticeship in 1904 and in 1908 became foundry foreman for the Hastings Foundry & Machine Co., Hastings, Nebr. He remained with that company for 2 years and then became associated with the Westover Foundry, Lincoln, Nebr., as core room foreman. He left that company in 1914 and served as core room foreman with the Paxton Mitchell Co., from 1916 to 1923 and with the Paxton Vierling Co., both of Omaha, Nebr., from 1923 to 1924. Mr. White purchased a half interest in the Gering Foundry & Machine Co., Gering, Nebr., in 1924 and served as manager until recently.

Steel Making Methods To Be Discussed

The fourth annual meeting of the metallurgical advisory board to the United States bureau of mines and Carnegie Institute of Technology, Pittsburgh, will be held Oct. 17. Problems in the manufacture of steel such as new methods of refining, conceptions of the functions of slags, and methods for the determination of various harmful impurities will be topics for discussion. A report on the study of iron-manganese-carbon alloys also will be given.

Methods of deoxidizing open-hearth steel which produce cleaner steel than that obtained at present, will be described in detail. Experiments cover small melts made in high-frequency, induction, furnaces; melts made in 300-pound, electric, furnaces; and a series of heats made in large open-hearth furnaces. Slags, one of the controlling factors in the production of good steel, have been a subject of special scrutiny by research engineers. Experiments in the laboratory and in plants indicate that certain properties of slag, which to date have been studied but little, have a decided effect upon the speed of working of the furnace and the ultimate reliability of the product.

Among the new ways of determining injurious impurities in steel are the electrolytic method for determining nonmetallic inclusions, the aluminum method for determining metallographically the amount of silicates present in a given sample of steel. These methods are so much faster and more accurate than older methods that experimental work has been speeded up tremendously and the correct answer to a number of operating problems now is obtained readily. Iron oxide may be determined in liquid steel with excellent accuracy in approximately three hours by the new method. That determination required from one to two days by older methods. Nonmetallic inclusions in steel may be determined by the inclusion count method in about 30 minutes from the time a sample is received, and a quantitative count of the oxides in steel may be made in from 24 to 36 hours by the electrolytic method. Weeks were required for these determinations by older methods. Fundamental data regarding solubilities and equilibria between the various constituents which make up the raw materials, slags and metals used in steel-making practice will be presented.

The meeting will open in the bureau of mines auditorium with an address of welcome by Dr. F. N. Speller, chairman of the advisory board and director, department of metallurgy and research, National Tube Co., Pittsburgh. Following this, metallurgists of the bureau of metallurgical research, Carnegie Institute of Technology, will give a progress report on iron-manganese-carbon alloys. Dr. F. M. Walters Jr., director of the bureau, Dr. V. N. Krivobok, Dr. J. D. Friauf, Cyril Wells, and Maxwell Gensamer, associates, will present papers on different phases of that study. Dr. Krivobok also will report on his studies on the stainless iron alloy which contains 18 per cent chromium and 8 per cent nickel. Discussion on that work will be presented by Dr. A. B. Kinzel, Union Carbide & Carbon Research Laboratory, Long Island City, N. Y.; F. T. Sisco, editor, *Alloys of Iron Research*, Engineering Foundation, New York; Byron B. Morton, Hydro Engineering & Chemical Co.; and Dr. H. W. Gillett, director, Battelle Memorial institute, Columbus, O.

During the afternoon session Dr. C. H. Herty Jr., physical chemist, United States bureau of mines, and Dr. G. R. Fitterer, associate metallurgist, will present an illustrated report on slag viscosity and deoxidation with aluminum-silicon alloys, and a progress report on fundamental studies in the laboratory. Dr. Herty will also deliver a report on plant research work in open-hearth steel. Discussion of the reports made at the afternoon session will be presented by Dr. R. B. Sosman, department of research and technology, United States Steel Corp., New York; Dr. A. B. Kinzel; Dr. D. F. McFarland, department of metallurgy, Pennsylvania State college, State College, Pa.; Louis Jordan, United States bureau of standards, Washington; C. D. King, United States Steel Corp., New York; J. H. Flaherty, chief metallurgist, Aliquippa works, Jones & Laughlin Steel Corp.,

Pittsburgh; and R. S. Simmons, research department, Pittsburgh Steel Co., Pittsburgh. Discussions also will be presented by German and English metallurgists.

The twenty-first meeting of the metallurgical advisory board will be held in the evening at the Pittsburgh Athletic club. It will be followed by an informal dinner at which Dr. Thomas S. Baker, president, Carnegie Institute of Technology, will preside. The speaker will be announced at a later date.

Mathews Conveyor Co., Ellwood City, Pa., has changed the location of the Pittsburgh office of the company from the McCance block to the Grant building. F. M. Fish, formerly in charge of that office, has severed his connection with the company and Sydney Wasley, formerly manager of the Youngstown district sales office has been made manager of the Pittsburgh office. Albert M. Kerr, formerly of the home office, will assist Mr. Wasley.

OBITUARY

William Gutenkunst, president, Milwaukee Malleable & Grey Iron Works and the Milwaukee Hay Tool Co., Both of Milwaukee, died recently at his home in that city.

James H. Adams, manager of the Adams Foundry, Rome, N. Y., since the death of his uncle the late Henry V. Adams in 1917, died Sept. 15, at the age of 53 after a brief illness of three weeks. The foundry was established in 1835 by his grandfather, the late Sanford Adams and was the subject of an interesting article in THE FOUNDRY Nov. 15, 1925.

Thurston W. Ludlow, 72, president and treasurer, Springfield Malleable Iron Co., Springfield, O., died recently at his home in Springfield. Mr. Ludlow was born in Springfield and had lived there all his life. He was born Jan. 21, 1858. He received his early education in Springfield and later attended Wooster college, Wooster, O. In addition to the presidency of the Springfield Malleable Iron Co., he was a director and officer of several Springfield companies. He also had been interested in civic activities.

Frank L. Driver, 60 years old, chairman of the board and one of the founders of the Driver-Harris Co., Harrison, N. J., died at Zoute Sur Mer, Belgium, Aug. 26. He had been in poor health for some time and for the past three years had made his residence in Brussels, Belgium. Mr. Driver was born in Brooklyn, July 4, 1870. Prior to the organization of the Driver-Harris Co. is 1899, he had been affiliated with John A. Roebling's Sons Co., Trenton, N. J. His son, Frank L. Driver Jr., is president of the Driver-Harris Co.

D. Owen Brooke, formerly secretary-treasurer, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., died Sept. 7 at his home in Birdsboro at

Foundry Association Directory

American Foundrymen's Association

President, N. K. B. Patch, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago; technical secretary, R. E. Kennedy, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass.; secretary, R. B. Bonner, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. McArthur, Washington Iron Works; secretary, W. J. Wark, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. Hire, Hire Foundry Co., Peoria, Ill.; secretary, Franklin Whitehead, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. Evans, Continental Roll & Steel Foundry Co., East Chicago, Ind.; secretary, Albert N. Wallin, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, James L. Mahon, American Car & Foundry Co.; secretary, William J. Muhlitner, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Ft. Shelby Hotel.

East Bay Foundrymen's Association

Secretary, O. R. Moller, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. Bull, Assistant Director, C. N. Ring; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, Walter L. Seelbach, Forest City-Walworth Run Foundries Co., Cleveland; secretary, Arthur J. Tuscany, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; secretary, Robert E. Belt, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, William Ember, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, William E. Paulson, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue.

Newark Foundrymen's Association

President, W. H. Mantz Atlas Foundry Co., Irvington, N. J.; secretary, G. W. Hannay, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president. Scheduled meeting dates: Oct. 22; Dec. 3; Jan. 28; March 25; May 27.

New England Foundrymen's Association

President, Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass.; secretary Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.; secretary, Robert Hoierman, 418 Penton building, Cleveland. Annual meeting Nov. 13 at Columbus, O.

Pacific Coast Founders Association

President, Charles J. P. Hoehn, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. Truitt, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. Hopkins, Ajax Metal Co., Philadelphia; secretary, Earl Sparks, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, W. E. Troutman, Duquesne Steel Foundry Co., Pittsburgh; secretary-treasurer, William J. Brant, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad City Foundrymen's Association

President, R. L. Eichman, Bettendorf Co., Bettendorf, Ia.; secretary-treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, Horace R. Culling, Carondelet Foundry Co., St. Louis; secretary-treasurer, Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis. Meetings the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, John S. Schofield, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. Dunn Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, George Batty, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. McCauley, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. Rogers, Graybar building, New York.

Tri-City Technical Council

Chairman, C. F. Scherer, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. Xander, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, William Hoppenjanz, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, William J. Snyker, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. Langdon, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. Orphan, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, Edward C. Gustin, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. Hornsby, Joplin, Mo.; secretary, E. L. Graham, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. Bornfleth, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

an age of 71 years. He was born April 19, 1859 near Gulph, Pa., and was educated in the public schools, John Loch's seminary, and the University of Pennsylvania. He went to Birdsboro in 1881 after serving in the laboratory of the Cambria Iron Co., Johnstown, Pa., and took a position as chemist at the blast furnace of the E. & G. Brooke Iron Co. Later while he was in the employ of the Pennsylvania Investment Co., he went to Kansas City, Mo., where he spent several years but returned to Birdsboro in 1896. At that time he became actively interested in the Brooke interests. He served as manager of the Brooke Land Co. and the Birdsboro Water Co. in addition to his position as secretary-treasurer of the Birdsboro Steel Foundry & Machine Co. He retired about 6 years ago because of ill-health.

Safety Goggle Fits Over Regular Spectacles

Chicago Eye-Shield Co., 2300 Warren avenue, Chicago, Ill., announces an improved safety goggle for workmen engaged on hazardous jobs, who

Safety Goggles Allow Glasses To Be Worn Under Them

at the same time require the use of corrective spectacles for defective vision.

The body of the goggle is molded of composition material, which is light in weight and moisture proof. Although it will fit directly over prescription glasses, protecting both them and the eyes from injury, it is no larger nor heavier than the average industrial goggle.

They are recommended for such operations as grinding, chipping, riveting, caulking and welding, in fact any industrial operation requiring clear vision and eye safety.

Lift-Truck Includes Safety Features

Barrett-Cravens Co. Chicago, has placed on the market a multiple lift-truck of new design, shown in the accompanying illustration. Special features include a spring handle-holdup which prevents the handle from falling to the floor, an automatic releasing latch to prevent the handle from flying up, and complete roller bearing equipment.

The lifting mechanism is inclosed to provide protection from dust and dirt.

A Spring Handle-holdup Prevents the Handle from Falling to the Floor

The load may be lifted by the operator with from two to eight strokes on the truck handle. Loads may be lifted with the handle located anywhere in an arc of 200 degrees which feature is included to aid material handling in cramped quarters or narrow aisles.

The truck is equipped fully with ball and roller bearings. A roller bearing is located on the kingbolt to aid steering. Protection from side thrust wear provided by the roller bearings it is claimed minimizes wear on axles, links, frames and wheel hubs.

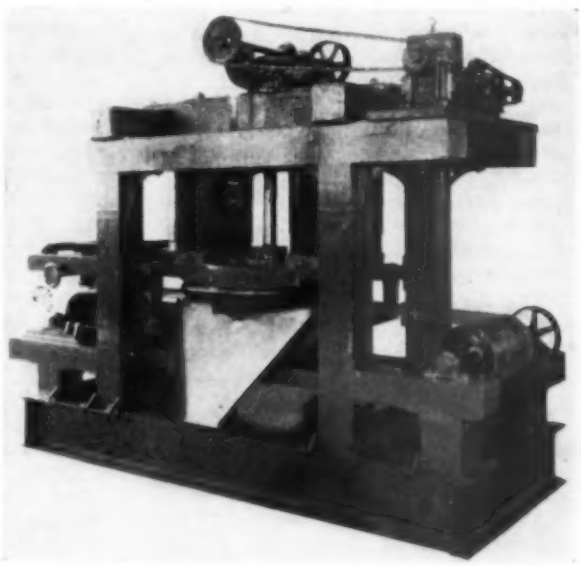
Pyrometer Designed for Brass Foundries

The new pyrometer recently developed by the Illinois Testing Laboratories, Inc., 141 West Austin avenue, Chicago, and described briefly in the Aug. 15 issue of THE FOUNDRY on page 82, utilizes a thermocouple which was developed at the plant of the Ohio Brass Co., Mansfield, O. The pyrometer is portable and is designed especially for measuring the temperatures of molten brass, bronze or copper either in the furnace or in the ladle. It operates on the thermoelectric principle and consists of a rugged but sensitive millivoltmeter with a scale indicating temperatures up to 2500 degrees Fahr., connected to the fire end by a pair of alloy extension wires enclosed in a supporting arm. When the exposed end of the thermocouple is heated, an electric current is set up which travels through the wires to the indicator. The current generated in the fire end increases with the amount of heat and deflects the pointer on the millivoltmeter.

The unit is self-contained and ruggedly constructed to eliminate accidents to the instrument and workmen. The indicator always is close to the operator to facilitate quick and accurate reading. The couple is connected to the shaft containing the wires leading to the temperature-indicating millivoltmeter by a shielded connector. The shield is provided with winged nuts to facilitate easy removal to renew or adjust the position of the thermocouple to any desired angle.

Magnetic Separator Has High Intensity

Magnetic Mfg. Co., Milwaukee, has introduced a magnetic saparator with high intensity for the separation of foreign matter from sand and other materials. It is claimed that the new unit makes possible the separation of materials which previously have been unresponsive to magnetic treatment. The apparatus is designed so that the material to be treated passes through a specially designed hopper which is located at the feeding end of a conveyor belt and which distributes it evenly over the belt. The material passes under a highly magnetized ring which revolves and seizes magnetic responsive material, moving it over and away from the nonmagnetic ma-



Special Chutes Are Used To Discharge Separated Material from the Machine

terial and discharging it into chutes at the sides of the separator. The unit is constructed so that the magnetized ring becomes neutralized as it revolves over the discharge chutes automatically releasing the separated material.

The magnet assembly is an integral unit which permits adjustments within the frame for varying magnetic capacities. The magnetic ring is fitted to a bronze disk which is actuated by a shaft mounted on ball and roller bearings. The ring is tapered over its circumference which is claimed to intensify magnetic action. Magnetic assembly weighs 12,000 pounds.

The separator provides direct magnetic action on the material to be treated. Material comes into direct contact with the magnetized ring as it revolves over the conveyor belt. The air gap, which insulates against magnetic attraction, has been reduced. The unit contains two electro-magnets with 140,000 ampere turns in the coil windings. The separator is a self-contained unit comprised of motor and speed reduction unit and requires no accessory equipment for its operation in a plant.

Crane Built for Heavy Duty Service

Harnischfeger Corp., Milwaukee, recently has introduced an improved type, heavy duty, overhead crane designed to withstand severe service. The bridge is constructed of standard box-section girders with adequate diaphrams and top plate supports. The bridge motor and gearing are mounted on a horizontal support rigidly connected to the girder. Bridge drive gears are enclosed fully in steel cases. Either the standard type cross shaft bracket or the pedestal type bracket can be supplied.

Low wheel loads and bearing pressures are maintained either by two or four wheel equalizing construction. Four wheels may be driven with the equalizing type truck, thus increasing tractive or breaking effort. Two types of bearings are available. The trolley is designed to meet service conditions. Sides are of unit cast steel box type construction connected by steel girts. A cross-shaft drive is used with two truck wheels being driven.

The main and auxiliary hoist mechanism is easily accessible. Large diameter drums, sheaves, shafting and heat treated gearing are claimed to give low maintenance costs. All trolley gears are enclosed in steel gear cases and run in an oil bath. Either roller or sleeve type bearings can be supplied.

The crane motors, designed for heavy duty are of the split frame type, rated on an hourly basis, and are equipped with roller bearings. The back axle type of motor can be supplied on bridge and hoist motions when desired by the customer.

Forces Lubricant to Equipment Parts

Robert Bosch Magneto Co. Inc., Long Island City, N. Y., recently has introduced a new type forced-feed grease lubricator applicable to foundry equipment. It is of simple and rugged construction and has the following distinctive features: Centrally located forced-feed pump with positive drive; working parts are enclosed completely, self-lubricating and easily accessible; and springs, ball valves and packings have been eliminated. The lubricator is claimed to require minimum driving power as the rotary movement of the pump shaft is converted directly into a reciprocating motion of the pump plungers without loss of power. The unit consists of the pumping units arranged centrally around the pump shaft, two cam disks mounted on the latter which actuate the pumping plungers and grease guide-plungers respectively.

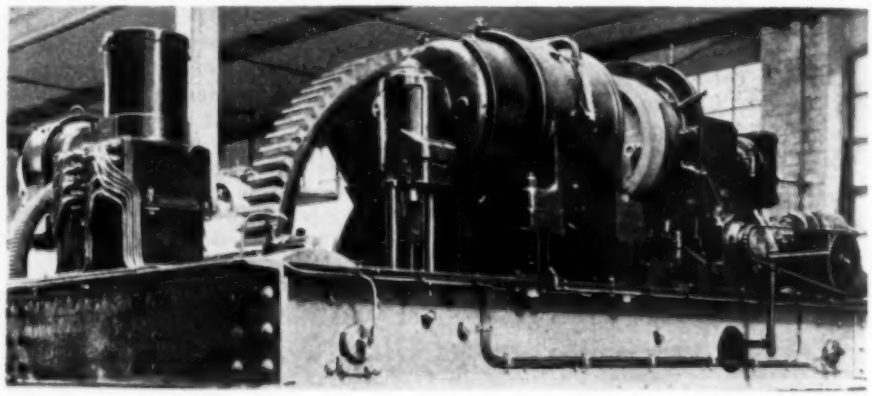
The apparatus consists of two parts, a cylindrical tank which serves as a container for the grease, the scoop and the helical feeder and the lower box shaped part which contains the entire pumping system with its worm driving wheel. The lubricator may be driven from any suitable moving part of the engine or machine connected to the roller ratchet and oscillating lever of the lubricator. Two alternative positions of the drive shaft are offered on either side of the outlets. The gear ratio between the drive and the pump shafts depend upon the normal speed of the machine. Maximum speed for the drive shaft is 400 revolutions per minute and the oscillating lever should move through a sector of not less than 10 degrees.

Rate of feed may be controlled either by the drive and ratio between drive and pump shafts or by the adjustment of the individual pump unit. When required, normal pump speed may be increased 25 per cent. Ratio of 2.4 to 1 for drive and pump shaft gears is recommended for installations where the lubricating points require fairly large quantities of grease. When small quantities are required, the ratio of 10 to 1 is preferred. A minor adjustment of the rate of feed also is obtained by variation of the length of the oscillating lever.

The unit is constructed so that varying quantities of grease may be delivered at different lubricating points. The stroke of each pump unit may be regulated independently by adjusting screws located on the front of the machine. A right or left turn of the screws decrease or increase the quantity of grease delivered. Any pump unit may be rendered inactive by turning the respective screw to the right as far as possible. Each pump unit has two discharge connections. When the apparatus is assembled, each pair of outlets must be connected to outgoing lines for lubricating points requiring about the same amount of grease.

Lubricators are provided with a hand crank which may be used for priming the feed-distributing system before starting, to insure that the machine or engine will start with lubricant in its bearings or to supply an additional quantity of grease for a short period.

The company also manufactures a line of oil lubricators of the forced-feed type for machines having more than 12 lubricating points.



Grease Lubricator Mounted on a Crane Trolley

Welding Rod Has a Low Melting Point

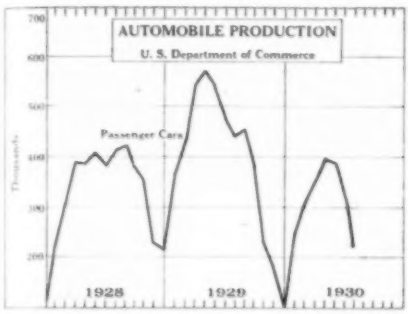
A new rod for the welding aluminum castings, which are held tightly in position and not free to expand or contract, has been introduced by the Oxweld Acetylene Co., 205 East Forty-second street, New York. The new rod is recommended by that company for aluminum casting alloys because its melting point is lower than that of the metal being welded. It will remain molten after the base metal has solidified. It is claimed that the weld metal will fill voids that may have been created by solidification or contraction of the base metal. Stresses caused by contraction will shift their effect from the base metal to the weld metal, which is free from hot shortness and will absorb them without developing cracks. It is available in three sizes 1/16, 1/8 and 1/4-inch.

Trade Trends in Tabloid

SENTIMENT in industry continues a gradual but slow improvement, backed by slight improvement in numerous lines. Steel founders, at the recent meeting at Pittsburgh, treated last quarter business possibilities with somewhat of an optimistic view. Gray iron foundries, in the main, report a perceptable increase in inquiries. Malleable shops are realizing slight increases in specifications from automobile plants and improvement in demand for nonferrous castings is apparent in some quarters.

—T—T—

Pig iron sales have increased during the past month in several centers, including New York, Cleveland, Toronto and Pittsburgh, and inquiry



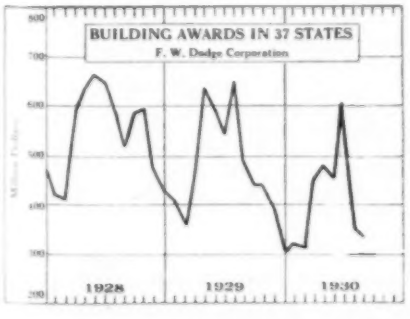
has improved considerably. Foundry operations in the Pittsburgh territory are moderately larger than a month ago. Most purchases are limited to early needs.

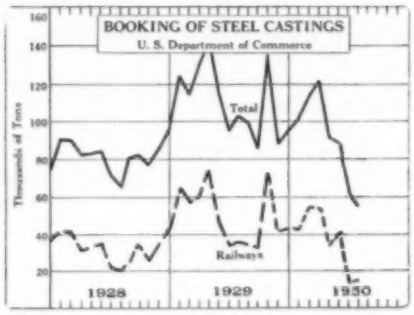
—T—T—

Construction awards in August, as reported by the F. W. Dodge Corp., totaled $347,318,300, a decline of 5 per cent over the total of $367,528,400 in July. Construction undertaken during the first 8 months of the year was valued at $3,352,860,000 compared with $4,156,865,300 during the corresponding period in 1929.

—T—T—

In the St. Louis district, manufacturers of farm implements and other products used chiefly in the rural areas, report distributors and dealers unwilling to stock more than current needs. Continued hot weather is attributed as a part cause to the disappointing demand for stoves and





other heating apparatus. However, the first substantial fall in temperatures is expected to bring a rush of orders.

—T—T—

Demand of machine tools continues to increase slightly. Reports from several centers indicate considerable activity in the designing departments. Developments in equipment should reach the production stage in the near future.

—T—T—

The electric steel foundry of the Otis Steel Co., Cleveland, shipped the largest tonnage of castings in the history of the company in August. The large volume resulted in orders for castings to be used in the construction of electric welding pipe mills.

—T—T—

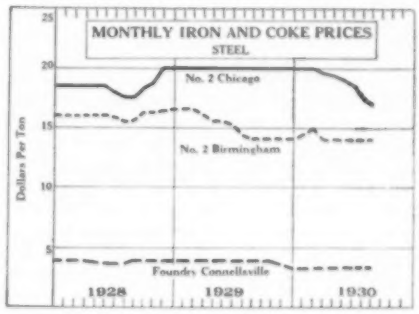
August automobile production dropped to the lowest level of any month during the past nine years, according to estimates of the National Automobile chamber of commerce. While production probably will fluctuate up and down slightly during the remainder of the year, the trend for the next three months will be slightly downward if the industry parallels the records for the past 4 years.

—T—T—

The Illinois Central railroad recently withdrew its inquiry for 2300 cars, bringing the list pending to approximately 110 cars, one of the lowest totals since 1920. Several car shops are cleaning up backlogs and others have been shut down for some weeks.

—T—T—

Unfilled orders for brass and bronze ingots and billets on the books



of the Nonferrous Metal institute declined 1027 tons or 5 per cent in August. Order backlogs on Sept. 1 were 19,298 tons.

—T—T—

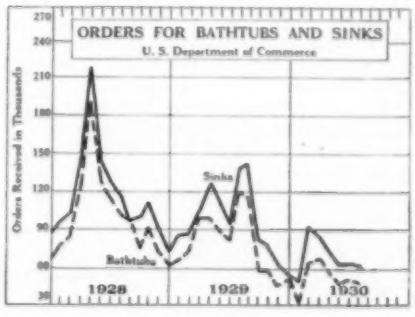
Loadings of freight cars for the last week of August increased for the third consecutive week to reach a new high weekly total for the year. The total for the week was 984,504 cars.

—T—T—

Steel mill operations during the third week of September remained stationary at an average of 60 per cent for the entire industry. Cleveland and Buffalo showed substantial gains, Birmingham remained stationary and Chicago and Youngstown declined slightly.

—T—T—

Improvement in cast iron pipe business, reported recently from Birmingham, now promises to be maintained throughout the year.



RAW MATERIAL PRICES
September 17, 1930

Iron	
No. 2 foundry, Valley	$18.00
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	18.50
Basic, Valley	18.00
Basic, Buffalo	18.00
Malleable, Chicago	17.50
Malleable, Buffalo	19 00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$15.00 to 15.50
Heavy melting steel, Pitts.	15.50 to 16.00
Heavy melting steel, Chicago	12.25 to 12.50
Stove plate, Buffalo	10.25 to 10.50
Stove plate, Chicago	9.50 to 10.00
No. 1 cast, New York	9.50 to 9.75
No. 1 cast, Chicago	12.00 to 12.50
No. 1 cast, Philadelphia	13.50
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.50 to 14.00
Agricultural mal., Chicago	12.25 to 12.75
Malleable, Buffalo	15.00 to 15.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	10.25 to 10.37½
Electro, copper, producers	10.75 to 10.87½
Straits, tin	29.85 to 29.90
Aluminum, No. 12, producers	22.00
Aluminum, No. 12, remelt	14.00 to 15.00
Lead, New York	5.50
Antimony, New York	7.75
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.25

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Dover Mfg. Co., Dover, O., is reported to have started full time operation.

Business is reported to be increasing at the Lincoln Foundry & Mfg. Co., Mt. Carmel, Ill.

Ferro Machine & Foundry Co., Cleveland, recently completed an addition to its plant.

Leonard & Baker Stove Co., Taunton, Mass., and the Barstow Stove Co., Providence, R. I., have consolidated.

Queen City Foundry Co., 391 Norfolk avenue, Buffalo, suffered a severe damage to four of its building by fire recently. Loss is estimated at from $150,000 to $200,000.

Michael Art Bronze Co., 231 Court avenue, Covington, Ky., will remodel its plant at a cost of about $900. B. T. Wisenall, Union Central building, has the contract.

White Mountain Freezer Co., Nashua, N. H., which recently was damaged by fire, has begun the erection of a 1-story addition. The new unit is estimated to cost $26,000 including equipment.

Fairfield Plow Co., North Fairfield, O., recently suffered a fire loss to one of its plant buildings. Loss included damage to several unoccupied units, estimated at $20,000.

Wilmington Castings Co., Wilmington, O., has acquired the Washington Metal Products Co., Washington Courthouse, O., and is moving equipment of the latter company to the Wilmington plant.

The foundry of the Chevrolet Motor Co., Saginaw, Mich., closed Sept. 6 for overhauling and changing of plant equipment and inventory. The plant was reopened Sept. 22.

Napoleon Foundry Co., Napoleon, O., recently organized, has taken over the plant of the Keenan Furnace Co., and has opened for the production of iron castings and patterns.

The Triplex Lawn Mower Co., Platteville, Wis., maker of power mowers, has disposed of its entire business including stock, tools and machinery, to White Machinery Co., Eau Claire.

Miller Foundry Co., 705 Anne street, Columbus, O., recently completed an addition to its foundry that practically doubled its capacity. New equipment also was installed.

Plant of the Massey-Harris Co., Batavia, N. Y., has resumed operations with close to capacity production schedules in several departments. The plant had been idle five weeks.

Flynn-Wolfe Bronze Foundry, Ardmore and Pennsylvania railroad, Swissvale, Pa., has been reorganized for the production of brass, aluminum and copper castings. J. H. Gordon is manager and treasurer.

Several plants at Chester, Pa., report good business. The Federal Steel Foundry Co. is operating 5½ days a week; Sun Shipbuilding & Dry Dock Co., 5 days and the Crown Smelting Co., 4 days.

Carroll Steel Foundry Co., Houghton, Mich., has plans under consideration for a plant addition, at present tentative. Construction may be started next spring. James R. Carroll is president and general manager.

Plant of Buffalo Foundry & Machine Co., 1543 Filmore avenue, Buffalo, manufacturer of automotive castings and products, recently was severely damaged by fire. Damage is estimated at about $40,000. J. A. Gauther is president.

Cornell & Underhill, 311 Spring street, New York, manufacturers of pipe and fittings, has leased a 2-story plant to be erected on the block bounded by Thirteenth, Fourteenth, Jefferson and Madison streets, Hoboken, N. J.

Superior Chain & Plating Co. Ltd., Windsor, Ont., has been incorporated with $40,000 capital by David W. Booth, Walkerville, Ont., and John Garrick, Flint, Mich., to operate brass and iron foundry.

Business of the Doehler Die Casting Corp., Batavia, N. Y., showed marked increase early in September, according to Charles L. Hodgson, vice president and general manager. Production may reach capacity during the final quarter.

Business is improving according to a statement issued by Henry Holth, Little Bros. Foundry Co., 326 Griswold street, Port Huron, Mich. The statement says that although business of the company is below normal at present it is improving gradually.

Gray Iron Foundry & Mfg. Co., Reading, Pa., has been incorporated with $25,000 capital by Samuel J. Wagner, 328 North Sixth street, to manufacture and deal in castings, machine products, mechanical devices, machinery parts, appliances and accessories.

A. Finkl & Sons Co., 1326 Cortland street, Chicago, has acquired a plant on South Port avenue, adjoining its present plant. The unit, formerly occupied by T. A. Cummings Foundry Co., will be used for expansion purposes. It is two stories, 150 x 150 feet.

General Bronze Corp., Long Island City, N. Y., recently closed contracts aggregating $800,000 to furnish white metal work to be installed in five large eastern buildings now being erected, including the Empire State building in New York city.

Foundry operations in the Chicago district remain at 40 to 50 per cent. Moderate improvement continues among the larger steel foundries, and brass foundries have had spurts of better business. Nevertheless, schedules as a whole show little change from most of the summer season.

Mesta Machine Co., Pittsburgh, has enough unfilled orders on its books to insure continuous operation of its machinery sections for the remainder of the year with a considerable volume to carry over into 1931, according to a statement issued by the Standard Statistics Co., New York.

Adrian Foundry & Machine Co., 414 Addison street, Adrian, Mich., recently incorporated, has begun production. The company occupies the building formerly occupied by the Maple City Brass & Aluminum Foundry. Franklyn H. Myers is president, Jules Vandecaveye, vice president and manager and Calvin H. Myers, secretary-treasurer. (Noted July 15.)

American Foundry Co., 1535 Naomi street, Indianapolis, will reopen not later than Nov. 1, according to Blaine H. Miller, president. The plant of the company was destroyed by fire recently with a loss of $750,000. A new plant has been constructed which includes eight buildings with a total floor space of 120,000 square feet. The largest building is the cleaning room which is 100 x 300 feet.

Among the foundries reporting good business in the Philadelphia district are the following: Simon Scullin Foundry, Fairmount Foundry Inc., American Engineering Co., Glenwood Foundry, Olney Foundry Co., and the Philadelphia Brass Foundry. The following plants in the same locality are among those working five days each week: Spring City Foundry Co., Spring City, Pa.; Doyleston Foundry Co., Doyleston, Pa., and H. W. Butterworth & Sons Co., Bethayres, Pa.

U. S. Cast Magnet Steel Corp., Union street, Lawrence, Mass., has been incorporated with $100,000 capital by Winthrop C. LeShanna and Carlene Wardwell, Watertown, Mass., and Dorothy A. Hogan, Brockton, Mass. The new company will be affiliated with the Lawrence Factories Inc., Lawrence, Mass. Plans have been prepared for 10,000 square feet of floor space to start operations. The company will manufacture cobalt steel castings and plans include the construction of a new steel foundry. Isidor Goldberg, president, Pilot Radio & Tube Corp., Brooklyn, N. Y., is reported to be the head of the new organization.

Trade Publications

ELECTRIC MOTORS—In two recent bulletins, General Electric Co., Schenectady, N. Y. describes induction motor-generator sets and synchronous motors.

UNIT PULVERIZER — Whiting Corp., Harvey, Ill., has issued for its subsidiary, the Grindle Fuel Equipment Co., a bulletin on its unit pulverizer for preparing coal for use in firing industrial furnaces and small boilers. Illustrations show characteristic installations and details of construction.

AUTOMATIC CONTROL—Ryan, Scully & Co., 3711 Wissahickon avenue, Philadelphia, manufacturer of industrial furnaces, forges, conveyors and automatic control equipment, has published a catalog of its line of automatic control equipment for use with gas, air or liquids in connection with temperature and combustion control. It contains illustrations and diagrams showing operation, purposes and sizes.